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The Sulphur-Content of Wool

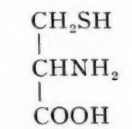
Its Influence, Distribution and Estimation

By A. J. HALL, B.Sc., F.I.C., F.T.I.

WOOL differs from cotton, particularly in the fact that it is composed not only of oxygen, carbon and hydrogen, but also of sulphur and nitrogen. The sulphur content is most probably of greater significance than has been supposed in the past, and it would appear that many of the properties of wool in contrast to those of cotton might be traced to the presence of sulphur compounds in wool and not in cotton. At any rate evidence has already been discovered that the physical properties of different types of wool differ with their sulphur contents. The sulphur content of wool is therefore important.

It is not difficult to demonstrate the presence of sulphur in wool. This may be simply done by warming the wool with a dilute solution of lead oxide in caustic soda; the wool rapidly blackens owing to the formation of lead sulphide. The actual estimation of the sulphur is somewhat more tedious and improvements in the methods of estimation employed are still being suggested. These methods will be dealt with later.

Wool consists mainly of keratin and analysis of this yields about 13% of cystine which has the following composition:



Cystine

Until the recent researches of C. Rimington (Biochem. J., 1929, 23, 41 and 726) only some 60% of the sulphur content of wool could be found in the cystine, and it was therefore an open question whether or not wool contained some other undiscovered sulphur compound. In these researches, however, Rimington modified the method for obtaining cystine from wool such that all losses of this substance were avoided; he was then able to show that 99.5% of the sulphur in wool could be accounted for in the form of cystine. Those interested in this substance as present in wool will find the following methods useful for isolating it:

Folin Method

100 grams of wool (first scoured mildly and then degreased by treatment with hot alcohol) are refluxed (J. Barritt; J. Soc. Chem. Ind. 1927, 46, 339T) for 6 to 7 hours just at the boil with 20 c.c. of concentrated hydrochloric acid whereby a dark-colored syrupy liquid is obtained. This is cooled, filtered, and then sodium acetate added until the liquid fails to show a blue color with Congo Red (about 220 grams of sodium acetate are required). Under these conditions of acidity the liquid, on standing for about 48 hours, deposits a dark precipitate containing both cystine and tyrosine; wool contains about 4% of tyrosine.

Abderhalden Method

Wool is hydrolyzed as in the Folin method described above, and the product then evaporated to dryness on a water bath under a reduced pressure of but 20 mm. The residual sticky mass is dissolved in water and again evaporated to dryness, this process being repeated three times. The residue is dissolved in hot water and just neutralized with sodium hydroxide (litmus as indicator), the solution being finally adjusted to pH = 5 by addition of acetic acid. Twice its volume of alcohol is then added and the mixture allowed to stand 24 hours for deposition of the cystine. This is collected, washed with water, and then alcohol, and then dried. The resulting crude cystine is whiter in color than that obtained in the Folin method.

The purification of the crude cystine obtained by the Folin and Abderhalden methods is effected by dissolving it in 5% hydrochloric acid and decolorizing the boiling solution (to a straw yellow color) by the addition of purified animal charcoal, then adding a

30% solution of sodium acetate until the liquid has pH = 5, whereupon cystine separates and the impurity (tyrosine) remains in solution. It is sometimes necessary to redissolve the separated cystine and again precipitate in the same manner. In this manner the pure cystine is obtained in the form of colorless hexagonal tablets which contain 26.7% of sulphur.

In turning to the distribution of sulphur in wool fibers and the sulphur content of various types of wools several interesting observations may be made. This subject has received the attention of the British Research Association for the Woollen and Worsted Industries and it must be said that the papers containing the results of original research issued by this research association are of great value and have led to the recognition of important characteristics of wool not hitherto suspected.

Over a period of several years various values have been obtained in determinations of the sulphur contents of wools and it could be assumed that different wools have differing sulphur contents. This view, however, has been laid open to doubt, and Trotman and Bell (J. Soc. Chem. Ind., 1926, 45, 12T) have suggested that such variations as have been found in the sulphur content are really due to errors of estimation. However, a series of careful determinations were carried out by J. Barritt and A. T. King (J. Text. Inst., 1926, 17, 386T) and it would appear that there can now be no doubt but that the sulphur content of wool is variable. For these determinations soap and alkali were avoided in the purification of the wool (a solution of saponin was used for scouring, and dirt and fat were removed by treatment with sulphur-free benzene) and the moisture content of the wool was taken into consideration. The sulphur was estimated by the Carius method. The following results illustrate differences in the sulphur contents of various wools:

Type of wool	Moisture regain	Sulphur content (calc. on dry weight)
Australian merino	16.44%	3.76%
Lincoln (white)	15.89	3.10
Lincoln (yellow)	15.95	3.26
Turkey mohair (fine)	15.64	3.36
Turkey mohair (coarse)	15.68	3.03
Peruvian	16.19	3.82
Montevideo (Rommey)	17.44	3.76
Welsh mountain	18.65	3.97
Cape merino (Kaffrarian)	16.47	4.00
Cape merino (Le Grange)	16.32	3.94

From the whole of the results obtained with 50 wools the sulphur content was found to vary between 3.03 and 4.13%.

It is interesting to note that coarse fibers generally appear to contain less sulphur than the finer fibers, and this is shown by the following results obtained by hand-sorting black face wool into three fractions from the same fleece:

	Sulphur content
Fine no-kempy fraction	3.82%
Coarse kempy fraction	3.33
Kemps	3.24

A similar result is shown in the sulphur content figures quoted above for Turkey mohair fibers (fine and coarse).

More recently Barritt and King (J. Text. Inst., 1929, 20, 151T) have investigated the distribution of sulphur within wool fibers and the effect of various treatments on the removal of this sulphur. The new facts are particularly interesting.

If the distribution of sulphur in wool fibers is considered purely on general grounds and without reference to actual determined values there are several facts which would point to the conclusion that the sulphur content of a wool fiber would diminish from the root towards the tip. For example, it would be remembered that during growth the sheep is dipped from time to time in sodium arsenite solutions and also that Bergen and others have shown that under the action of light the sulphur in wool is converted into sulphurous or sulphuric acids which can be removed by weathering or washing. It seems that external influences capable of removing sulphur from wool fibers while growing on the sheep are likely to be more effective on the tips of the fibers. The work of Barritt and King, however, shows that in fact the distribution of the sulphur is quite otherwise—the sulphur content is higher at the tip than at the root. The following results illustrate this point:

Sample of wool	Portion	Sulphur content (calc. on dry weight)
Australian merino.	About 1 inch from tip	3.41%
	Remainder of fiber	3.27
Australian merino.	About 1 inch from tip	3.62
	Remainder of fiber	3.39
Albury wool.	About 1 inch from tip	3.08
Albury wool.	Remainder of fiber	3.00
	Tippy half of wool	3.66
	Root half of wool	3.40
Lincoln wool. (Staple 11 inches)	Tip portion 1 (nearest tip)	3.65
	Tip portion 2	3.58
	Tip portion 3	3.53
	Root portion 4	3.59

Not only does the tippy portion of a wool fiber contain a higher proportion of sulphur, but it has also been found that white wool usually has a higher proportion than black wool.

It is thus seen that the most recent researches show the sulphur content to vary with the type of wool and that this sulphur increases towards the tip of the wool fiber. And just as the sulphur in vulcanized rubber is of the utmost importance in determining the properties of the rubber so does it appear that the sulphur

in wool fibers has a large influence on their spinning properties. Hence the necessity for investigating the sulphur content of wool.

In the wet processing of wool materials, as in dyeing and scouring and also in the wearing of wool garments, various influences come into play whereby the sulphur present in the wool can be removed; the effect of these processes are interesting and have been investigated by Barritt and King (J. Text. Inst., 1929, 20, 159T). In scouring processes wool comes into contact with such alkalies as sodium carbonate and ammonia. The following results indicate that when these processes are carried out carefully the floss of sulphur is small:

Wool	Treatment	Sulphur content (calc. on dry weight)
New Zealand	Cleaned with benzene	3.47%
	Commercial scour (0.2% of soap and 0.1% sodium carbonate)	3.44
	Heated with 2% solution of sodium carbonate (100 c.c. per 1 g. wool) at 50° C. for 30 mins.	3.28
	Heated with 2% solution of sodium carbonate (100 c.c. per 1 g. of wool) at 60° C. for 60 mins.	3.18

Quite early in the history of textile chemistry, Chevreul stated that by repeated treatment with lime wool could be almost completely freed from sulphur. This result could not be confirmed by Farrar and King (J. Text. Inst., 1926, 17, 588 T). In connection with "limed" wool the point is of importance and so it has received the attention of Barritt and King. Their results given below indicate that lime does progressively remove sulphur. In these experiments 20 grams of wool were thoroughly shaken with one liter of saturated lime water and, at intervals, about 4 grams of the wool were removed and the sulphur content determined; the remaining wool was washed, whizzed, and then again treated with a fresh one liter of lime water, this treatment being repeated again and again.

Time of treatment of wool	Sulphur content
0 hours	3.66%
24	2.89
72	2.37
96	2.30
250	2.10

The non-shrink finish for wool materials is another process which affects the sulphur content of wool, and the following results show the extent of the changes produced:

Chlorination (calc. on weight of wool)	Sulphur content
0 %	3.27%
1.24	3.23
3.0	3.20
5.6	3.03
10.4	2.94
20.7	2.67
31.2	2.35

It was noticed that the moisture regain of the chlorinated wool steadily decreased from 16.4% to 12.75%.

The conclusion which must be reached from the various investigations noted above is that when the ordinary wet processing of wool is carried out under normal conditions no substantial loss of sulphur occurs, and the wool should therefore not show any appreciable deterioration.

Before concluding this article one or two methods for determining the sulphur present in wool will be described. All of these methods depend on the oxidation of the sulphur to sulphuric acid and the estimation of this in the usual manner by means of its conversion into insoluble barium sulphate by treatment with barium chloride. The methods differ mainly as regards the process of oxidation.

Carius Method

This is the same method as is frequently used for the determination of sulphur in all kinds of organic compounds. It consists of placing the wool with fuming nitric acid in a sealed glass tube and heating the whole in a gas or electric furnace until oxidation and decomposition of the wool is complete.

Denis-Benedict Method (Modification by Trotman & Bell)

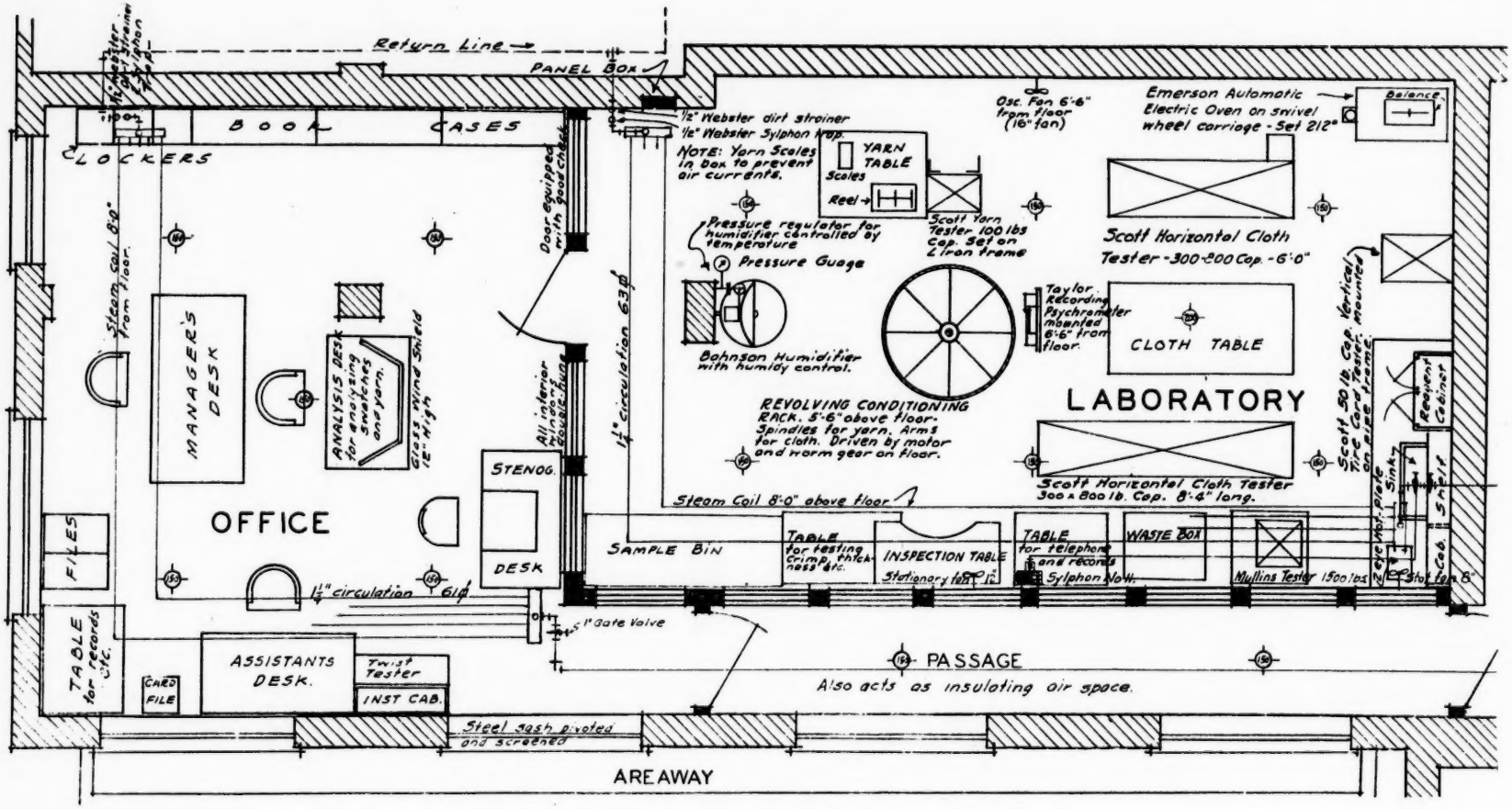
About 0.2 gram of wool is just dissolved in a pure sodium hydroxide solution, then a few drops of bromine added, and after a few minutes sufficient nitric acid added to neutralize the alkali; the product is then oxidized with the Denis-Benedict solution as described.

Denis-Benedict Method (Modification by Rimington)

About 0.25 gram of wool is placed in 10 c.c. of hydrochloric acid (2 parts of concentrated hydrochloric acid and 1 part of water) contained in a silica crucible and the whole heated until the wool just dissolves. Then 1 c.c. of the following Denis-Benedict solution added:

Copper nitrate	25 grams
Sodium chloride	10 grams
Ammonium chloride	10 grams
Volume	100 c.c.

and the mixture evaporated to dryness. A further 4 c.c. of the Denis-Benedict solution is added, followed by evaporation, and the residue then ignited. The residue in the crucible is then extracted with boiling 10% hydrochloric acid and the sulphuric acid content of the extract determined by addition of barium chloride and filtering off the precipitated barium sulphate in the usual manner.


Return Line
PANEL BOX
BOOK CASES
CLOCKERS
Steam Coil 8'0" from floor.
MANAGER'S DESK
ANALYSIS DESK for analyzing sneakers and yarn.
Glass Wind Shield 12" High
Door equipped with feed check.
All interior finish of Cypress
1½" circulation 63ft
STENOG.
DESK
OFFICE
FILES
TABLE for records etc.
CARD FILE
ASSISTANTS DESK.
Twist Tester
INST CAB.
1½" circulation 61ft
1" Gate Valve
Steel sash pivoted and screened
AREAWAY
½" Webster dirt strainer
½" Webster Sylphon Trap
NOTE: Yarn Scales in box to prevent air currents.
YARN TABLE
Scales
Reel
Pressure regulator for humidifier controlled by temperature
Pressure Guage
Bahnson Humidifier with humidy control.
Scott Yarn Tester 100 lbs Cap. Set on C Iron frame
Osc. Fan 6'6" from floor (16" fan)
Emerson Automatic Electric Oven on swivel wheel carriage - Set 212°
Balance
Scott Horizontal Cloth Tester - 300-800 Cap. - 6'0"
Taylor Recording Psychrometer mounted 6'6" from floor.
CLOTH TABLE
LABORATORY
REVOLVING CONDITIONING RACK. 5'6" above floor. Spindles for yarn. Arms for cloth. Driven by motor and worm gear on floor.
Scott Horizontal Cloth Tester 300 x 800 lb. Cap. 8'4" long.
Scott 50 lb Cap Vertical Tire Cord Tester mounted on cleat frame.
Regional Calculator
Steam Coil 8'0" above floor
SAMPLE BIN
TABLE for testing crimp, thickness etc.
INSPECTION TABLE Stationary top 1½"
TABLE for telephone and records
Sylphon Nov.
WASTE BOX
Mullins Tester 1500 lbs
Sink
Stat fan 8"
PASSAGE
Also acts as insulating air space.

Equipment Not Shown on Plan

1 *Erinmyer Flask*
6 *Extraction Tubes*
2 *Condensers Coolwater*
1 *Torsion Balance Scales*
1 *Even Balance Scales*
1 *Suter Dissecting Glass*
1 *Suter Twist Tester*
1 *Old Type Twist Tester*
1 *Bausch & Lomb Microscope*
1 *Randall Stickney Micrometer*

1 *Universal Yarn Assorting Mach.*
1 *Improved Universal Assorting Balance*
1 *Triplex Thread Counter*
1 *Pick Glass 1" Gauge*
1 *Pick Counter 1½" Gauge*
1 *Reversible Magnifying Glass*
1 *Inspection Box for Colored Fabrics*
1 *Inspection Plate*
1 *Pocket Microscope No. 40*
1 *4" x 4" Steel Template*

1 *2" x 2" Steel Die with Mail*
1 *3" x 3" Steel Die with Mail*
1 *Henry Baer Carding Machine*
1 *Torson Balance Box*
1 *Desicator*
1 *New Balance Scales*
1 *Auxiliary Motor*
1 *Marchant Calculating Machine*
1 *Adding Machine*
1 *12" Typewriter*

Liquid Transmission Regitherm.
Sylphon No. 11 with 1" Valve and 15' 0" of Flexible Tubing. Set for 72 deg. F.
1" Gate Valve

Manufacturers named herein are suggested and could be substituted by others whose products are equal. Arrangement by R. H. Adams in 1925.

The Testing Laboratory and its Relation to the Textile Mill

By R. H. ADAMS, Callaway Mills, LaGrange, Ga.

WHILE the testing and research phase of Southern textiles is still in its infancy, enough has been done to indicate the immediate possibilities of service and the adaptability of some form of such activity to practically every type of organization.

It is with this aspect of the matter that I am concerned in this paper. Doubtless the elementary remarks here presented would be much more appreciated before a different audience. They afford me the opportunity, however, of "getting into the record," orally at least, a brief argument in favor of testing extension and a picture of my own comparatively simple but efficient outfit in the General Offices at LaGrange.

At the present time textile laboratories in the United States are divided generally into groups—those operated as a part of a single mill organization and those operated for mutual benefit by a group of mills. These units have grown to the point where they are of great importance to the success of the industry, since they are actually the only scientific agencies for originating new methods, improving existing processes, and solving the many manufacturing problems which face the mill executive.

Before the establishment of the textile laboratory, practically all material was produced against specifications supplied either by the purchaser or developed solely and expensively for standard production through bitter experience. Specifications from the purchaser were generally limited, and still are, to performance factors. For instance, that the strength must be so much in one direction, and that the burst must be so much in either direction. Usually it was known for what job the material was designed. But without means for research and testing, it happened many times that in meeting the specifications a great deal of costly work was done which ranked simply as a dead loss, before the proper manufacturing conditions were located through the rule of thumb method which most mills followed.

With the establishment of the textile laboratory, the necessity for this crude method of solving problems was eliminated. The research specialist in charge of the laboratory of today is a scientist in the textile field. With the equipment at his command, he is able not only to work out the tensile strength of the individual yarn or fabric, but is able to calculate the tensile strength necessary to meet practically any specified job. Through his ability to specify raw stock, method of spinning, method of weaving, and finish, he is a source of immediate profit to his organization.

The results of the first textile laboratory units were received with a doubtful enthusiasm by the mill executives. The fact that these results were reached with the aid of instruments, and without using a bale or two of cotton beforehand, made them seem unreal. As, however, case after case proved the rightness of the calculations, men who had originally opposed the idea became its strongest supporters; so that today wherever a mill has a testing laboratory in its organization or at its command, the manufacturing group are only too glad to submit their problems to the laboratory, knowing full well that these will be solved as promptly and economically as possible.

Not only does the textile research specialist assist his organization through calculating methods for new problems, but he also proves of great value through constantly studying, searching, testing, to find better and more economical means of producing the standard fabric of his organization on a basis of higher quality and lower cost.

For the mill just establishing its own research and testing laboratory three things are necessary. A skilled textile research specialist, who is acquainted with the scientific side of textiles as well as with mill machinery and its manipulation, should be selected for the work. He must be tactful, as he will be brought into close relations with foremen and superintendents, and must be able to get over to them his understanding of their problem and his desire to assist them in solving it. His workshop, the laboratory, must be equipped with the necessary machinery and instruments to do his job. The most thoroughly trained man in a scientific field is helpless without his equipment. Finally, the laboratory should not be bound by ordinary rules. Much of their work is in exploring new fields, meeting and solving new problems; therefore, they must set up their own rules of operating to a very great extent.

In developing the routine work of a textile testing laboratory there are three important questions to consider, namely: the physical, the analytical and the chemical.

The physical question deals with the mechanical properties of the manufactured products, such as the determination of tensile strength, stretch and elonga-

tion, the effect of twist upon strength and its relation to proper tension in weaving, the absolving qualities of cotton of different kinds, the moisture regain of different fabrics in process under the same conditions, and the action of moisture on yarns and fabrics.

The analytical process should be organized in such way that the one in charge of a laboratory may take any sample received for duplication and analyze the weave and construction as to count, yarn numbers, weight, thickness, percentage of warp and filling, twist, and the raw materials that it will take to produce a like fabric.

The chemical section should be equipped to handle any kind of finished materials that may be presented for extraction, dissection or identification of fibers, for determining percentage of sizing compounds, estimate of finishing materials used, the reaction to acids, to washing and to sunlight.

The laboratory equipped for routine testing of textile materials should be properly built, with plenty of room, abundant light, and with tables and machines so arranged as to save time and energy. Especially important is it that standard atmospheric conditions be provided, as all results of value depend on the conditions under which tests are made. Naturally the basic factors of relative humidity or cotton regain must be established under standard conditions before dependence can be placed upon the results of the tests enumerated above.

All materials of current production should be tested daily. They should be carried to the laboratory and thoroughly conditioned in an atmosphere which is as near to a standard as possible to maintain; and after conditioning, the test should be made under the same conditions. The moisture should be checked, and records of the results should be made and compared with previous records. If this method is followed a standard for all yarns and fabrics can be made, and deviation from this at any time can be promptly corrected by checking closely with the mill.

Special yarns and fabrics being developed against specifications should be tested in every stage of development; should be checked carefully for weight, tensile strength and construction, and every detail should be recorded and results checked with specifications. Tensile strength should be kept well above the margin required by specifications.

As to the methods of testing, there are many in use by consumers of fabrics. Those devised and published, however, by the A. S. T. M. are the best to follow, and it is the opinion of the writer that the testing of textile materials, especially cotton fabrics, may be confined to two methods. These are the 1½" strip method and the 4 x 6" grab method. Also, either of two conditions of moisture may be employed, the one at bone dry and the other at a definite regain as 6½%. The idea of standardizing both these methods is suggested for the reason that most fabrics are now tested in a general way by either one or the other. However, it is the writer's opinion that the 4 x 6" grab method at 6½% regain is more suitable for all woven fabrics, since it gives a true relation between the warp and filler strength. It is also more easily and quickly applied.

The laboratory has come to stay in the textile industry, and to intelligently take care of our present needs, as well as to plan for the future, we must provide such an agency as certainly and naturally as we would any other part of our manufacturing equipment. Only through its aid may we materially improve our product, reduce our costs to the lowest degree, and be sure of shipping a finished product that we know is right. Much has been said in recent years, and many volumes have been written, on the subject of textile laboratories; but, as in the case of Mark Twain's weather, "Everybody has talked of it, but very few have done anything about it."

The attached blue print is a suggested plan for a laboratory, showing the minimum floor space and the correct placement of equipment. This particular laboratory has been in operation for about four years, and is equipped to handle between 40,000 and 50,000 samples per year. The nature of its location and construction has enabled us to carry an average temperature for four years of 78.29 degrees, and to maintain an atmospheric condition that is as near standard as is possible in a southern climate. Under all kinds of weather conditions the light is evenly distributed. The equipment is conveniently placed, and includes a revolving conditioning rack with 100 spindles for yarn, and space for about 100 half-yard full width cloth samples. It is driven with a one-fourth h.p. motor and makes about two revolutions per minute. The room is provided with positive humidity control, and has a complete artificial circulation to keep down the stratification of moisture as far as possible. This laboratory has proved to be thoroughly practical for routine testing and the plan is offered for the consideration of any who may be interested in the general subject.

Certainly in our day when the tremendous speed of style and merchandise movements necessitates coordinated action in every industry in the country, it is vitally necessary that the textile mills have at their command scientific means for solving manufacturing problems promptly, accurately and efficiently. The textile research laboratory is the scientific unit on which the mills must depend. On the efficiency of the research work and the extent to which it is used by the industry will depend in large measure the future importance of the textile industry in relation to the manufacturing groups of the country.

This paper was presented at the Charlotte, N. C., meeting of Committee D13 of the American Society for Testing Materials, March 13, 14, 1930.

Proceedings of the American Association of Textile Chemists and Colorists

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FEBRUARY MEETING OF THE NEW YORK SECTION

THE February Meeting of the New York Section of the American Association of Textile Chemists and Colorists convened Friday evening, February 28, 1930, in the club room of the Building Trades Employers Association, 2 Park Avenue, at eight-fifteen, P. F. Kingsbury, Chairman of the Section, presiding.

The routine business of the Section was transacted.

Chairman Kingsbury: Our first speaker this evening, gentlemen, is Dr. H. Meyer, of the Technical Staff of the General Dyestuff Corporation, who will talk to us about "The Dyeing of Vat Colors on Wool." Dr. Meyer, (Applause)

The Dyeing of Vat Colors on Wool

By DR. H. MEYER
General Dyestuff Corporation

INDIGO, the oldest and for a long time the only vat color, has been used to a large extent for dyeing of wool and although the coal tar dye industry has brought us a number of Chrome Blues of excellent fastness properties, Indigo is still in use, especially for the dyeing of uniform cloth where the highest fastness requirements have to be satisfied.

When at the beginning of this century Indanthrene was invented and in succession an ever-increasing number of other vat colors, it was natural to try to utilize these colors of unsurpassed fastness to light also for dyeing of wool. But it was found that this could not always be done. First—Indanthren Blue R S, for instance, for reduction requires a large amount of caustic soda, considerably more than Indigo and as a temperature of 120-140° F. is necessary for the dyebath this high percentage of alkali would be detrimental to the wool fiber even in the presence of glue, etc. At that time it was found already that the potash compound of the Leuco-Indanthren Blue stays in solution even at ordinary temperature, but as Sodium Hydrosulphite is used for reduction an intermolecular exchange takes place and the vat is not stable at a lower temperature for any length of time.

The second obstacle was that the Leuco compound of Indanthren Blue R S had not much affinity for wool.

Another way to make vat colors which need a large amount of caustic for reduction adapted for wool dyeing which was tried was to bring the color in solution with the necessary amount of caustic and then cut down the alkalinity of the dyebath by adding chemicals which bind

the caustic alkali, such as ammonium salts, bicarbonates, aluminum salts, etc.

These methods date back to the earliest developments in vat colors and later have been even patented in U. S. Patent No. 1,148,966. This way nearly every vat color can be brought out of solution and to go on the wool fiber, but in many cases it is not a question of dyeing, but of precipitation. For proper dyeing it is necessary that the Leuco compound has sufficient affinity for wool. I am mentioning these different points to bring out the requirements for a vat color to make same a good color adapted for wool dyeing; it has to stay in solution with a comparatively small amount of alkali and the Leuco compound has to have a good affinity to the wool fiber. A group of vat colors based on these principles and selected for their excellent fastness properties are the Helindon colors offered by the General Dyestuff Corporation. Our sample card I. G. 63 illustrates on page 26 and 27 this line of colors to which in the meantime Helindon Yellow R and Helindon Brown C R D have been added new.

This line includes a full range of colors in yellow, red, brown, blue, violet, green and black and as you may see from the large number of combination shades nearly every shade in demand in the woolen industry may be produced with Helindon colors.

The Helindon colors are offered in the form of unreduced paste or powder which are brought in solution like Indigo with alkali and hydrosulphite. But a number of Helindons we also offer in a more convenient form, as stable reduced vats, either liquid, in grains or powder. The latter, the "Vat Powders" are the latest achievement and the easiest in handling. After mixing with about ten times the amount of boiling water and letting stand for 5-10 mins. a perfectly clear solution is obtained ready to be added to the dye vat. We are, of course, trying to finally bring out all the Helindon colors in this Vat Powder form.

All the "Vat" brands are the Leuco compounds with a minimum of alkali, that is, just enough to form the sodium salt of the Leuco compound. To the dyebath, glue or Leonil S is added to keep the color in colloidal solution, then a small amount of ammonia, just enough to give a pink reaction with phenolphtalein, is added to keep the bath slightly alkaline and hydrosulphite to counteract the oxidation by the air and finally the stock vat prepared from the unreduced color or the solution of the vat brands.

Attention is called to the fact that glue solutions prepared from commercial glue very often show acid reaction and a little ammonia should be added in this case. For dissolving the vat brands, clean vessels should be used. Wooden pails in which acid solutions, acetic or sulphuric, are prepared, are generally soaked with acid and enough is left to throw the vat colors out of solution.

For practical purposes we are dividing the Helindon colors into two groups according to the best dyeing method.

The colors of the HN group are dyed at 120-130° F. and the bath is kept only slightly alkaline. If no standing bath is kept the bath may even be exhausted by adding slowly a diluted solution of sulphate of ammonia, until the pinkish reaction with phenolphtalein has disappeared altogether.

The brands applied according to the HW method are dyed at a higher temperature, 140-150° F. and require a little more alkali. We do not recommend the exhaust method for this group which includes:

Helindon Orange R
Helindon Pink R
Helindon Red B and B R
Helindon Violet B B N
Helindon Blue 3 G
Helindon Brilliant Blue 4 B
Helindon Brown 3 R

All the HN brands if necessary for shading purposes may also be used according to the HW method.

The Helindon colors are best adapted for the dyeing of wool in the form of raw stock and slubbing. One method to dye raw stock is the apparatus as generally used in Indigo dyeing. A rectangular tank with a basket a little smaller in size which can be lifted out of the liquor and a pair of squeeze-rollers. These machines generally hold about 600-700 gals. and have a capacity of 70-75 lbs. loose wool. The vat is prepared as mentioned before with 3 per cent glue, 1-3 per cent ammonia, 25 per cent according to the depth of shade and 2 per cent hydrosulphite and the solution of the reduced color. After standing for about 5 mins. the wool is entered and brought under the liquor by poling. After the material is all wet out by the dye liquor, it is only necessary to pole occasionally. After an immersion of 30 minutes the basket is lifted and the loose wool passed through the squeezing-rollers. Care should be taken that the material is not exposed too much to air before being put through the squeezing-rollers, that is, the loose wool is put through the rollers right away, while the basket is slowly lifted. A good squeezing is very important to remove the dye liquor as much as possible, otherwise the oxidized dyestuff settles on the fiber and causes crocking, besides the liquor, especially if too much hydrosulphite is present may strip the color and cause white tops. The material is then left oxidizing in heaps or in boxes and then rinsed, or for full shades a second dip is given.

If no standard formula is established after 20 mins., a sample is taken and if necessary additions of solutions

of the reduced colors are made, but as the dyeing is done in small lots of 70 lbs., the proper shade is generally obtained by changing the proportions of color in the following lots and mixing the lots together. By working this way a standing bath is kept which is replenished with ammonia, hydrosulphite and color; the latter being cut down 10-20 per cent. In one machine about 10 dips may be figured a day.

More economical are the circulation vats which are closed and in which the dye vat is circulated through the material. The material is tightly packed and 200-250 lbs. may be dyed in one dip.

If no squeezing-rolls are available, Helindon colors may also be dyed in an ordinary open dye kettle according to the exhaust method, which is also generally used for top dyeing and more fully described later.

Slubbing may be dyed in any machine in which the circulating dye liquor is not exposed too much to air. A machine of the Hussong type for instance has too much air exposure. In the Franklin machine it is advisable to lengthen the pipe on the overflow and carry the dye liquor under the surface. Obermaier and similar machines work satisfactorily if the dye liquor is kept high enough to prevent too much splashing.

Lately a number of machines for dyeing of slubbing are built from alumina; this, of course, excludes the use for dyeing of all Helindon colors where caustic alkali is present, but we found that even in the case of the reduced vats where only ammonia is used in the dyebath, at the temperature of 120° and higher, the ammonia reacts with the alumina.

As the dyeing temperature is only 120-150° proper care has to be taken that the material is tightly and evenly packed to get a good penetration and have all the air removed which otherwise shows as white spots.

Owing to the smaller amount of dye liquor, 1 lb. glue, ½-1½ lbs. ammonia and 1-1½ lbs. Hydrosulphite for 100 lbs. slubbing are sufficient. The material is first wet out for 15 mins. at 160° preferably with the addition of 8 oz. Leonil S per 100 gals., then cooled down to the dyeing temperature of 120° resp. 140°, glue if necessary, ammonia and hydrosulphite added and then the vat solution through a sieve or cheese cloth. After running for 30 mins., a diluted solution of Sulphate of Ammonia (1-4 lbs. for 100 lbs. material) is slowly added within 15 mins. and after another 10 mins. cooled down by running of the dye liquor and adding cold water. The material should always be covered and not exposed to air until cooled down to 80°. Then the color is oxidized by the addition of 2 lbs. Hydrogen Peroxide, run for 10 mins. raising the temperature to 90° F.

The use of Hydrogen Peroxide over other oxidizing agents such as Sodium Peroxide, Perborate, Persulphate, etc., has the advantage that no foreign substance is added, the Hydrogen Peroxide only forming water after its action as oxidizing agent and only slight rinsing is necessary.

The colors of the H W group after oxidation need a hot treatment with acid for full development.

In this connection it may be mentioned that in order to get the best fastness to light and the full development of the shade dyeings with Helindon colors should be submitted to a temperature near 200° to boiling temperature. This treatment the goods generally get in the finishing of the piece goods by decatizing, and as a rule it is not necessary to give such a treatment during the dyeing process. In sampling, however, it is necessary to submit the sample after proper oxidation to a steaming process; a little beaker with perforated bottom, on which the sample is laid and an open steam pipe inserted, which is always available in a dyehouse, is very useful for this purpose.

Another way to apply Helindon colors on slubbing is in the back-washer. Indigo has been used this way for pearl shades for quite some time, and trials in a practical way have shown that it is feasible to use the Helindon colors in 2 and 3 color combinations and even for full shades this way with very uniform results. This method corresponds exactly with the dyeing of cotton warps continuously with vat colors. The slubbing being in the dye liquor less than a minute altogether at a temperature not higher than 150° F., and practically no handling, the material, of course, is kept in excellent condition and in spinning quality is hardly any different from white material.

As mentioned before we recommend Helindon colors especially for dyeing of loose wool and slubbing, as small differences in shade can easily be corrected by mixing. The use on yarn becomes more difficult, when exact matching is necessary although when dyers get more acquainted with these colors, these difficulties will also be overcome. You remember the many objections when Indanthren colors were first introduced for dyeing of yarn and now this method is in general use.

The dyeing of piece goods is only possible in specially constructed machines, such as used in England for dyeing of Indigo, but I do not know of any such machine in this country. The material is always immersed under the liquor, but the passage is much longer than, for instance, in jig dyeing.

Another point I want to mention is the influence of the water. Although for dissolving the vat colors or preparing the stock vats, soft or condensed water is preferable, in dyeing, water of any hardness can be used and given even fuller shades on account of better exhaustion, the lime and magnesia salts cutting down the alka-

linity. If only soft water, such as for instance permutit water is available we recommend an addition of 1-4 per cent Sulphate of ammonia at the start for the HN colors and 5-10 per cent Chloride of Calcium for HW brands. The only exception is Helindon Blue 3 G which gives the best results in soft water.

We now come to a question which I have often been asked and to which you probably also are anxious to get an answer; the question of price. This question cannot be answered in a general way as the costs of dyestuffs alone do not give a fair comparison. If we take shades for which cheap Chrome Browns, Yellows and Reds are used and figuring only the dyestuff cost, Helindon colors naturally are much higher, but if we come to a blue like, for instance, this sample for which it is necessary to use more expensive colors, the case is different. What can you use to produce this shade and meet the highest requirements as to fastness. You may use an Alizarine Blue S K Y combination and get very good fastness to light, but the color in strong fulling is liable to bleed or go down in strength or you may use Chromoxane Pure Blue with excellent fastness to fulling, but you probably will get complaints about light fastness. On the other hand you dye with Helindon Brilliant Blue 4 B and at practically the same cost for dyestuff you produce a shade of excellent fastness both to light and fulling. But in figuring the costs of dyeing, the costs for dyestuffs are not the only points to be considered, in light shades they are even negligible. Additional very important factors are steam, labor, production. In producing fast dyeings with chrome colors 2-3 hours boiling is necessary in chrome topped dyeing and 4-5 hours when dyeing on a chrome mordant, not counting additional shading necessary for matching. This requires quite some steam. When using Helindon colors the temperature in dyeing is 150° to the most, but even figuring on a higher temperature in wetting out and scouring, the consumption of steam is very small. By practical mill tests it was found that for dyeing 100 lbs. of wool in a certain shade with Helindon colors, 45 lbs. of steam were required, whereas when using Chrome colors 340 lbs., i.e., 8 times the amount of steam, were consumed. There is also a saving in time and labor. A dyeing with Helindon colors including wetting out and oxidation takes about 2 hours. With a certain equipment the daily output can be greatly enlarged.

The lower temperature and the shorter time in dyeing, of course, keeps the woolen fiber in much better condition. The wool retains its natural strength and luster, and the goods produced have an excellent feel as you may judge from the different samples of cloth. With the same kind of wool a much better fabric is obtained; on the other hand a cheaper grade of wool may be used to get the same class of goods. I had occasion to watch comparative tests in a worsted mill. Wool dyed with Helindon colors in combing gave 12-13 per cent noils, whereas with the same grade of wool in white 9-10 per cent noils were obtained. The same shade dyed with chrome colors produced 25 per cent noils, which, of course, would make this latter method impractical.

The tensile strength of yarn from Helindon dyed yarn is also higher and I can give you the following figures from practical mill tests made a number of years ago:

Yarn chrome dyed—resistance 414 grams in Schopper tester;

Yarn vat dyed—resistance 492 grams in Schopper tester;

Helindon dyed yarn runs much better in weaving and less breakage occurs; the fulling qualities are also better. These points all have to be considered to make a fair comparison as to cost.

In fastness properties Helindon colors come up to the highest standards, both from the manufacturing standpoint and in wearing qualities. The fastness to fulling, carbonizing, crabbing and stoving is excellent. In finishing we do not recommend decatizing under high pressure. The fastness to light and weather of shades produced with Helindon colors is excellent.

We have in the line of Chrome colors a number of dyestuffs of very good fastness to light, but practical tests have shown that in a long exposure, especially combined with exposure to weather, as in the case of uniforms, even the best combination of Chrome colors is inferior to dyeings with Helindon colors. Helindon colors, therefore, are the logical dyestuffs to be used for uniform cloth for army and navy. In quite a number of countries the government specifications demand the use of Helindon colors. These specifications are not based on laboratory tests, but on practical tests in wear and tear.

Helindon colors are also used abroad to a large extent in the dyeing of wool and slubbing for uniform cloth for police, railroad or private use, for overcoatings and better grades of men's wear.

On account of the excellent fastness to washing water and saltwater Helindon colors are ideal colors for knitting yarn for sweaters and bathing suits.

Another field for Helindon colors is the carpet industry, where the fastness requirements for the better grades are getting more severe. They are already in use in the East, especially as they stand up very good in the washing process used for producing the antique effect on oriental rugs. Helindon colors are also in practical use for tan, gray and taupe shades in uni-rugs generally dyed in the loose wool.

In finishing I would like to draw a parallel with the use of vat colors in cotton dyeing. When the Indanthrens as the pioneers in vat dyeing were brought out the new

method of working—Indigo dyeing was restricted to comparatively few large mills—met many objections and matching was considered to be very difficult, but if we look around, the most successful in our trade are the dyers who in time grasped the trend for fast colors and familiarized themselves with this new class of dyestuffs. Now the amount of vat dyed cotton or similar material goes well in the millions. The same objections may be made by the wool dyers, but by going a little more into details they will find that vat colors offer no special difficulties in wool dyeing and in fact are just as easy to handle as Chrome colors. I feel sure that with the growing and general demand for fast dyeings Helindon colors will come in use more and more.

Discussion

Chairman Kingsbury: I am sure Dr. Meyer will be glad to answer questions if there are any.

Mr. Sinck: I would like to inquire if you can make a Government shade as fast with Helindon colors as you can with chrome colors?

Dr. Meyer: You refer of course to the Government tests?

Mr. Sinck: The Government tests, soap and soda.

Dr. Meyer: No, they don't stand up as well. That is one of these cases where those soap and soda tests don't correspond with practical use, I guess we all agree on that. In those tests for Government cloth they also use lactic acid and they don't correspond with practical use. Even in Chrome colors we always have difficulty finding a good combination. We could give even Chrome colors in a much better combination if they would only require fastness to light.

Mr. Sinck: Would the fastness to light be superior with Chrome colors?

Dr. Meyer: No, Helindons are better, especially when it comes to a long exposure.

Mr. Joryarch: Are the Helindon colors soluble in organic solvents?

Dr. Meyer: Some of them are. What do you mean by "solvents"?

Mr. Joryarch: In something like Naptha.

Dr. Meyer: Some may be soluble. Do you refer to dry cleaning?

Mr. Joryarch: Yes.

Dr. Meyer: We know that a lot of vat colors are soluble in those solvents and we would have to divide them up and select which ones were soluble and which were not.

Mr. Sinck: Dr. Meyer, you suggested salting the bath out in a dyeing gradually with ammonium sulphate. Could sodium sulphate be used there in small quantities with equally good results?

Dr. Meyer: No, because it is a matter of getting rid of the soda alkalinity. Sulphate of ammonium has a slightly acid reaction which sodium sulphate has not.

Mr. Wingate: Could these formulae that you apply for the dyeing of wool be applied to silk as well? Would they have the same effect?

Dr. Meyer: There is really no use for them in those colors because silk is less sensitive to alkali. You can use ordinary vat colors.

Mr. Wingate: They take a very large percentage of the dye.

Dr. Meyer: Do you refer to those reduced colors?

Mr. Wingate: Yes.

Dr. Meyers: For silk dyeings you can use nearly all vat colors. Take for instance the blacks. You can use up to 1½-1¾ ounces per gallon without doing any harm to the silk which of course you couldn't do in wool dyeing.

Mr. Kaltenbach: What is the comparative cost with Indigoids, for instance, for the same color value and the same color? What is the difference in cost between the two dyestuffs? The different Indigoid colors, the different Indigoid vats?

Dr. Meyer: Compared with what?

Mr. Kaltenbach: With your Helindon colors?

Dr. Meyer: The Helindon colors are a selection of vat colors. Some of them are Indigoids.

Mr. Kaltenbach: I imagined so. But how much more do they cost?

Dr. Meyer: They are the same price.

Mr. Chaky: Could you apply the Helindon colors with wool and cotton mixtures?

Dr. Meyer: You could not because the affinity of those colors is different. You wouldn't get a uniform shade.

Mr. Baume: I should like to inquire if the Helindons change a very great deal when they are subjected to steaming.

Dr. Meyer: If you decatize under heavy pressure they change the shade a little.

Mr. Bume: Does that present any difficulty in establishing those—that is, matching given standards?

Dr. Meyer: No, as mentioned before, you submit your sample to a steaming process also with the little apparatus I described and you get the same result.

Mr. Bume: You can duplicate the result?

Dr. Meyer: Yes.

Mr. Wood: Dr. Meyer, you haven't touched on the subject of printing wool with vat colors. I wonder if you could offer anything on that?

A great many years ago I was at the Badische plant and they showed me a process for printing wool with zinc-on-sodium hydrosulphite. I wondered if that was

still the current method of printing on wool with vat colors.

Dr. Meyer: Vat colors are used very little in wool printing.

Mr. Wood: But they might be used if there was an easier way to use them.

Dr. Meyer: They have been tried over and over again but there has been no way found as yet to use them.

Member: Indigosols are the only thing.

Stewart Carter: When you were speaking of some of the past efforts that were made for dyeing vat colors on wool I was reminded of a patent, a British patent, taken out five or six years ago, in which the vat was made reduced and then the alkalinity of the vat was reduced by the addition of lactic acid. I think it was used down to a quarter of one per cent. I never heard if that was in practical use.

Dr. Meyer: No, it is not in practical use.

Mr. Hansen: Would these products be of any use in bluing wool stock in a continuous wool stocking machine?

Dr. Meyer: Yes.

Mr. Hansen: Would you require peroxide?

Dr. Meyer: No, it is not necessary, you just pass through the vat, acidulate, and then you can put right in the dryer.

Mr. Chaky: Dr. Meyer, you said before that you have to pass the wool from the bath through a squeeze-roller quickly because the liquor oxidizes on it or the tips of the wool stay white. Does that mean that the Helindon colors are not as stable as the Indanthrene?

Dr. Meyer: No, you have the same thing in Indigo dyeing. If you don't squeeze out the liquor, the dye liquor dissolves some of the Indigo from the fiber.

Mr. Chaky: About how much time does it require to oxidize in the open air?

Dr. Meyer: At higher temperature it oxidizes very quickly, perhaps a few minutes.

Mr. Sinck: I don't know whether it is permissible to ask this question or not, but may I ask if these Helindon colors belong to the Thioindigo group entirely, or are there some Anthraquinone dyes?

Dr. Meyer: I nave nothing definite about the chemical constitution but they are most of them of the Indigoid class.

Chairman Kingsbury: Are there any more questions, gentlemen? If not, we will pass on to our next speaker, Mr. N. D. Harvey, Jr., of the Carbide & Carbon Chemicals Corporation, who will talk to us on "New Solvents and Their Relation to the Textile Industry." (Applause)

New Chemicals and Their Application to the Textile Industry

By N. D. Harvey, Jr.

Carbide & Carbon Chemicals Corp.

During the past few years a number of new organic chemicals have become available. These products have many unique properties which indicate their application and use in new fields. Among these new products is ethylene glyrol and its derivatives. Ethylene glycol has found wide use as an anti-freeze in automobiles, aeroplanes, refrigerating systems and in certain types of sprinkler systems.

The monoethyl ether of ethylene glycol is known as Cellulose having the structure—$CH_2OHCH_2OC_2H_5$. Cellulose is a pure organic liquid of slight pleasant odor, boiling at 134.8° C., completely soluble in water, and possessing marked solvent properties. Cellosolve first appeared commercially as a solvent for nitrocellulose, and is used widely in the formulation of all types of lacquers, these being characterized by their lack of odor. Further investigation brought to light the fact that the solubility of certain classes of dyestuffs was increased markedly by the use of this ether, notably the Indigosols, basic colors and their lakes, acid and chrome dyestuffs. By those directly concerned with the application of coloring matter to textiles in one or all of its countless ramifications, the benefits derived from a suitable solvent are readily appreciated. In any of the operations of printing, padding and dyeing, it is essential that the dyestuffs be in the finest possible dispersion. Just as stock, yarn, or cloth must be saturated evenly with water to allow the penetration of the dye liquor, so the color must be evenly and finely dispersed and in complete solution to enable its penetration with the liquor. The textile used acts as an excellent filter for all undissolved, suspended particles, and as a result a surface deposit is formed which readily crocks, giving rise to poor fastness and inferior color value. Many dyeing assistants are offered, each with its particular merits, but it is fairly safe to say that no one is suitable for all dyestuffs and all applications. Dyes of the same class are individuals in themselves and must be treated as such. In recent years, excellent work has been carried out in an effort to increase our knowledge of the characteristics of the dyestuffs we use, thus enabling the employment of correct conditions for optimum results. The pH of the dyeing solution, and its temperature are factors which must be controlled exceedingly accurately. However, conditions differ and procedures must be developed for individual cases until such time as all operations and individual dyestuffs are standardized. As mentioned above, Cel-

losolve is an excellent solvent for a great many dyestuffs but must be used correctly. In general, it may be said that above a certain degree of solubility of the dyestuff, its affinity for the solution is greater than its affinity for the textile. There is a maximum point reached where the optimum in color value is obtained, and above or below which condition, color value is lost. The correct amount of solvent will realize economy in increased color value, brilliance, penetration and consequent fastness to washing and crocking. In the printing of basic color lakes, Cellosolve, being an excellent solvent, prevents precipitation of the insoluble tannate until penetration and evenness have been obtained. Its action is identical with that of acetic acid but is lacking in the disagreeable odor of the latter.

The appearance of oil and grease spots on fabrics, as well as the accumulation of soot in sections where the atmosphere is laden with smoke, renders the operation of spotting a very necessary but serious consideration. Oil solvents such as the chlorinated group are very efficient. Sulphonated oils have been found very effective in floating carbon particles from the textiles. When incorporating large amounts of solvent in a soap or sulphonated oil, the immiscibility of the two is overcome by the use of a mutual solvent such as Cellosolve which forms a homogeneous mixture. Such a product emulsifies in water and forms a very efficient scouring and spotting material.

The coupling properties of Cellosolve for oil dispersions with other immiscible chemicals may be extended to its use in increasing the emulsifiability of fatty oils in water. Here again its combined fatty oil and water solubility increases the dispersion of the oil in water, thus reducing curding tendencies and increasing the stability of the resulting emulsion.

The combination of two molecules of ethylene glycol with the elimination of water forms the compound diethylene glycol, with the structural formula—$CH_2OHCH_2OCH_2CH_2OH$, one of the most interesting chemicals which has been brought to the attention of the textile industry. The properties of diethylene glycol are a combination of those of glycerine and alcohol, and yet it is distinctive in itself.

Diethylene glycol is a colorless, odorless, hygroscopic liquid boiling at 245° C., with a freezing point, —10.4° C., and a flash point of 255.2° F. Its viscosity is somewhat greater than that of water but less than that of glycerine. Compared to the latter with regard to the hygroscopicities of each, it may be said that the maximum amounts of water held by each is about equal. However, diethylene glycol gains weight more rapidly in a humid atmosphere, while it loses moisture more rapidly under dry conditions. Due to a lower viscosity, this material is not gummy nor sticky, and also is readily miscible with water. Its stability is a very important factor to all applications and we find diglycol unaffected by dilute acids and alkalies, non-corrosive, does not evaporate, and does not alter in chemical properties when exposed to the atmosphere. Diethylene glycol is a solvent for nitrocellulose but does not affect paint nor leather apron cement. When present upon leather in appreciable quantities, a softening action is evidenced, but no deterioration.

Among the most interesting of its many applications, is that of a textile lubricant for wool and worsted. Its physical and chemical properties are admirably suited for such a purpose and rather economical results have been realized.

The properties, chemical and physical, of a wool lubricant which are the most desirable from all angles of the question, have been the subject of much thought ever since the advent of the wool and worsted industry. Oils are the universal lubricant, and may be of a fatty or mineral nature, or mixtures of different members of the groups. The more suitable have been separated from the less desirable, but the best have limitations which as yet have not been overcome. In general, it may be said that a wool lubricant should possess

1. High lubricating properties
2. Ability to form stable emulsions
3. Stability toward atmosphere, dilute acids, and alkalies.
4. Low cold test
5. Easy washability

It will be agreed that an oil, or combination of oils, possessing such characteristics is difficult to obtain at a reasonable cost. The lubricating properties of a mineral oil are exceptionally good, but its adoption is not favored because of difficulties encountered in its removal from the yarn or cloth. On the other hand, fatty oils oxidize to a certain degree and then become exceedingly difficult, if not impossible, to remove. Certain of them, notably red oil, oxidize at a rate sufficient to cause fires from spontaneous combustion. This chemical change results in a darkening of the oil, thus discoloring the stock, and often creates rancid odors. Everything taken into consideration, a pure olive oil is, perhaps, the one lubricant which will cause a minimum of difficulties. This oil oxidizes, to be sure, but to a less extent than others.

The appearance of the wool fiber under the microscope is a familiar picture to all textile manufacturers. The scaley exterior contributes the felting property of

the fiber, but also necessitates the use of a lubricant to allow even carding, combing and drawing of the stock with a minimum of staple breakage. This latter factor is a direct function of the interlocking of the exterior scales and the friction resulting from the passing of one fiber past another. Thus, with proper lubrication, the above factors are eliminated. An oil or oil emulsion upon textiles may be compared to the use of oils in the case of moving parts of machinery. A film is formed upon the surface of each to prevent actual contact and to minimize friction and deterioration. There is always the danger of the film being unable to withstand the friction encountered in carding, combing and drawing. This being the case, the protective film is disrupted, fiber surface is exposed, and breakage will occur. This situation is evidenced by the fly waste and droppings around the machinery. In fact, it may be said that many of the difficulties common to all wool and worsted mills are directly traceable to the character or application of the lubricant.

Diethylene glycol is not an oil. This one distinguishing factor in itself seems as important as all others combined. It is generally believed that the solution to the problem is the development of a material possessing ideal lubricating properties, extreme stability and solubility in water. From the properties mentioned above, diethylene glycol fulfills the two requirements concerning stability and water solubility. Strictly speaking, diglycol is not a lubricant in the accepted interpretation of the word. Rather it is a softener. No protective film is formed, and fiber contact is not prevented. The material is applied diluted or undiluted, as particular cases may require by the methods usually employed. Diethylene glycol is completely absorbed by the fiber, and as in the case of all oil lubricants, the application must be uniform to allow uniform absorption. The fiber is softened, as are the exterior scales. The hygroscopic lubricant attracts moisture into the stock to further increase its working properties. The stock will be lacking in the customary wet, oily feeling. Instead, it will be decidedly softer, damp rather than wet. During carding, combing and drawing, the protection given by the oil film is accomplished by the soft, flexible condition furnished by diethylene glycol. The degree of lubrication may be measured by the degree of softness noted, rather than the degree of wetness. The real test, of course, is in the carding. Friction now is eliminated by the presence of diglycol. Interlocking of scales is prevented by the flexible condition of the scales, which allows them to bend under any slight pressure incurred by contact with other fiber surfaces. The absence of a film as the sole protection, decreases the fly waste and uneven yarn resulting from the disruption of this film. The preservation of the original fiber length, plus the smooth working of the stock, insures an even, soft, round, strong, evenly twisted yarn. The stock is snow white and lacking in the yellowness imparted by oils. Its odor is decidedly sweeter. The manufacturer may store this yarn for months, with the assurance that, when put into operation once more, it will have retained its original softness and whiteness. As a point of interest, comparative tests of the strength and elongating properties of two yarns, one of which contains emulsified olive oil, and the second diethylene glycol, showed, in the latter, an increase of 10% in strength and 35% in elongating ability. This, of course, is of importance from a manufacturing standpoint.

In cases of yarn dyed stock, scouring is essential to remove lubricating oils, as their presence in the wool dyebath which is acidified can only result in trouble. Oil is set free which will cling to the yarn, thus preventing satisfactory absorption of the dye liquor. Unevenness is the outcome. This illustrates the economic advantage of a water soluble lubricant. The scouring operation is eliminated, and with it the tendencies toward harshening of the yarn, which is a constant menace in all scouring operations. Coupled with its water solubility, diethylene glycol, as a dye solvent for the acid and chrome colors, is an assistant for the dyeing operation. In other words, greater economy results from the retention of the lubricant through increased color value, brightness and penetration of the resultant color.

In woven gray goods still containing diethylene glycol, the use of an alkaline fulling and scouring soap is dispensed with. The lubricant is removed with water, and thus the use of a strictly neutral soap precludes all dangers of harsh fabrics and bleeding, faded colors.

A further application of a lubricant is found in the manufacture of carpet yarns. The nature of the stock used is dependent upon the type of carpet to be manufactured. In many cases, an unscoured wool blend is employed, while in others a completely scoured base is desirable. Under such conditions, an added specification must be fulfilled by the lubricant to be used. It must have no solvent nor loosening action upon the natural wool grease, as partial or complete removal of these impurities will cause an accumulation upon the card clothing. This clogging not only decreases the production of the machine through the necessity for more frequent stripping and cleaning, but also lowers the carding efficiency upon the stock.

Diethylene glycol exerts a decided softening and loosening action upon the grease and thus is not practical upon unscoured stock. However, during the same investigation, other points of interest were noted. The stock was decidedly more soft. As a consequence, the tension set upon the condensor aprons as sufficient for oil lubricated stock was found to be excessive for stock carrying diglycol. In other words, this stock condensed more readily into roving, thus increasing the life of the leather aprons through the decrease in rubbing pressure needed, while the twisted yarn showed increased strength and softness. Thus, its use is of advantage upon scoured stock only.

These softening and penetrating properties of diethylene glycol are of further interest in such important processes as silk soaking, throwing, softening, sizing, knitting and finishing. The advantages to be gained are rather obvious in the light of the known properties of this chemical. Its ability to penetrate and thus carry other oils into the interior of yarns and fibers, as well as its hygroscopicity, are the underlying factors in its ability to produce improved finishes and increased workability in yarns. A more even, thorough absorption of the oil by the yarn leads to greater efficiency in subsequent processing, with less breakage and a softer finished product. Diethylene glycol is a valuable adjunct in sizing and starch finishes because of the increased penetration obtained, lack of tackiness and even, pliable starch film deposited. The softening properties should not be confused with those of fats, fatty oils and soaps, as this material contains no fatty ingredients to which are attributed softening action. Rather, diglycol should be compared to glycerine, in that its benefits are derived from its hygroscopicity and conditioning action. It has been claimed that diglycol restores softness to cotton which has been over-boiled in the kier, but it is believed that diethylene glycol is more beneficial as a softener when used in conjunction with other oils. On the other hand, in cases of pure lubrication exclusive of softening, it seems that this material possesses decided merit. As a winding oil or rayon lubricant, diglycol should be of decided interest. Also as a knitting oil where color, odor, corrosion and ease of removal are very important to the preservation of the softness of the fabric. In all cases, a thorough knowledge of the particular properties of the material in question and the judicious application of this knowledge is essential to good results.

In addition to the acid and chrome dyestuffs, the dye solvent properties of diethylene glycol are applicable to the dyeing and printing of basics and vats. The nature of this action is not clearly understood. In printing, many are of the opinion that its hygroscopicity is the deciding factor, although in the printing of basic lakes, there must be from necessity solvent action to prevent the precipitation of the lake prematurely. At the temperature of the ager, a certain amount of water is still held by diglycol. This moisture, in addition to the solvent itself, forms a temporary medium for the solution of the color or the leuco base in the case of vat dyes, thus allowing the fine dispersion to penetrate evenly into the fabric. The high boiling point of the solvent maintains this state of solution long enough to permit thorough, even penetration of greater color value and brilliance through the increased solubility of the dye.

The monoethyl ether of diethylene glycol is known as Carbitol, of the structure — $CH_2OHCH_2OCH_2$-$CH_2OC_2H_5$. Carbitol is a colorless, odorless liquid boiling at 198° C. It is completely soluble in water, slightly hygroscopic, and somewhat similar to diethylene glycol in some characteristics. Suggestions as to its possible applications would include its use as a coupling agent and softener in soluble oils and soaps. As a lubricant, its similarity to diethylene glycol offers possibilities upon cotton, rayon and silk as a protection and softener. Its decreased hygroscopicity might be of an advantage upon rayon.

Carbitol possesses valuable dye solvent properties for certain Indigosols and basic colors, and as such offers the advantages generally realized from increased dye solubility. An interesting sidelight is the application of Carbitol to the compounding of all types of soaps, as well as cosmetics, where advantage is taken of its softening ability with a minimum of drying action upon the skin.

If the three atoms of hydrogen in ammonia are replaced by three ethanol groups—CH_2OHCH_2—the compound, triethanolamine, is formed of the formula—$(CH_2OHCH_2)_3N$. Triethanolamine is a pale yellow, rather viscous, odorless liquid boiling at 277°-279° C. at 150 mm. It is the mildest alkali available, possessing an alkalinity about one-sixth that of ammonia, a pH of about 10.2, but the exceedingly unique property of forming soaps with fatty acids. Triethanolamine will form the oleate, stearate and palmitate with the corresponding fatty acid, and also will form soaps with the fatty acids of the common oils. The procedure involved is simply that of adding one molecular weight of triethanolamine to one molecular weight of the fatty acid and stirring without heat. The reaction is a mild, exothermic, chemical addition with the formation of an anhydrous soap. These soaps are characterized by their low alkalinity—pH about 8.6, stability, ability to stand high dilutions

with water without appreciable loss in consistency, their complete solubility in water, naphtha and mineral or fatty oils. As detergents, they are comparable to ordinary soaps, but preferable for use on textile fibers because of their neutrality.

Uses for soaps possessing these characteristics immediately suggest themselves. Wool, worsted and silk are extremely sensitive to alkaline materials. Accurate control must be exercised in all processes involving the use of basic chemicals to avoid harshening and partial gelatinizing of the fiber. The scouring of raw stock, fulling and scouring of piece goods, and the degumming of natural silk are operations requiring careful supervision. The use of water soluble materials in place of oils and emulsified oils would go a long way toward eliminating the damages incurred by the unintelligent use of alkalies. A neutral soap having a pH of 8.0 to 9.0 is harmless and yet fully as efficient as a more alkaline compound. A stable emulsion should readily wash without the necessity of jeopardizing the soft finish of the fabric. Triethanolamine oleate produces finishes upon woolens and worsteds not obtained with other soaps simply because of its efficiency as a fulling lubricant, as a softener, and finally, its neutrality. This low alkalinity is a further assurance that the finished fabric will retain its original brightness of shade and clear whites.

The solubility of triethanolamine oleate in naphtha offers the opportunity for compounding excellent spotting agents. In concentrations below 5%, the neutral triethanolamine oleate is not soluble in naphtha without the use of a mutual solvent such as Cellosolve, butyl Cellosolve, ethylene dichloride, or Hexalin. In concentrations above 5% the soap is readily soluble. Such a solution, containing a second solvent forms a simple, economical, highly efficient spotting compound. It seems preferable to use a neutral or slightly alkaline soap in naphtha to preclude the possibility of residual fatty acid remaining in the fabric through incomplete saponification.

Soaps are excellent emulsifying agents for oils, fats and waxes. In using triethanolamine for such a purpose, a slightly different procedure is often used to advantage. For the emulsification of oils in water, the required amount of oleic acid is dissolved in the oil, and triethanolamine is added to an arbitrary volume of water. The water solution when poured into the acid-oil mixture with stirring, immediately emulsifies the latter. In the case of waxes such as paraffin, carnauba, or beeswax, stearic acid is preferable to oleic but the procedure is not altered. These emulsions are of interest because of their stability, their tolerance of temperature change without separation, and finally their ease of preparation. The soluble types of oils are also formed by dissolving triethanolamine, oleic acid, water, and a mutual solvent in the oil to form a clear solution which, when added to water, emulsifies spontaneously. A mutual solvent is of great assistance in such mixtures, as the emulsified oil has a decided tendency to curd in water. Materials such as Cellosolve and butyl Cellosolve, being water soluble and also miscible with oils, increase the dispersion of the oil, thus reducing its tendency to curd, and increasing the stability of the emulsion. Butyl Cellosolve is miscible with mineral oil, Cellosolve is not, while the reverse holds true with certain of the fatty oils.

Triethanolamine is a stabilizer for emulsions and as such holds oils in suspension in scouring liquors. In the stripping of soaking oils and lubricants from yarns, the free oils often form a scum upon the surface of the liquor. In such cases, small amounts of triethanolamine have stabilized such suspensions and held the solution in a clear condition.

Another interesting consideration is the use of triethanolamine in knitting oils for natural silk. Free fatty acid is corrosive, while the common alkalies loosen the silk gum, thus allowing it to flake and clog the needle eyes. Triethanolamine may be used to advantage in the preparation of an oil just slightly on the alkaline side. The use of triethanolamine with the common sulphonated oils allows of more complete neutralization, and their use in the formulation of knitting oils of a neutral character is of advantage. Being water soluble, emulsification difficulties are dispensed with and the acidic nature of this class of material which has usually been held in disfavor no longer is a factor.

The dye solvent properties of triethanolamine for vat dyestuffs form the basis for a patent now held on its use in vat printing pastes. Being hygroscopic, its action is very similar to that of diethylene glycol in the same connection. Its low alkalinity is of considerable importance in dyeing, as well as printing, because appreciable amounts of the base cause very slight changes in the pH of the solution. Consequently in operations where accurate alkalinity control is an important factor as in dyeing, emulsification, scouring and similar processes, triethanolamine permits of more accuracy than do the common alkalies.

The next materials of interest come under the well known group of chlorinated solvents in which are included carbon tetrachloride, trichlorethylene, and tetrachlorethane. Two additions have been made, namely, ethylene dichloride — CH_2ClCH_2Cl — and dichlor ethyl ether—$(CH_2ClCH_2Cl)_2O$. These materials are colorless liquids possessing distinct

ethereal odors, each insoluble in water but strong solvents for fats, waxes, grease, oil, paint and tar. Ethylene dichloride boils at 83.5° C., burns with difficulty, and is the stronger solvent of the two. The ether boils at 178° C. The two materials are extremely resistant toward hydrolysis in the absence of strong alkalies. This fact distinguishes them from other members of the group, as chlorinated solvents in general hydrolize appreciably in the presence of moisture. Hydrochloric acid is formed, which is corrosive toward equipment and injurious to vegetable fibers. As a consequence, even though the solvent properties are superlative, their use is confined to specialized uses. Ethylene dichloride and dichlor ethyl ether fill a long needed gap simply because of economy and stability.

Solvents of this type have wide application in spotting and scouring solutions to remove lubricants, oil stains and grease spots. They may be incorporated in sulphonated oils, oil emulsions and soaps to enhance detergency but in incorporating appreciable amounts the use of a mutual solvent must be resorted to. For processes involving low temperatures, ethylene dichloride is preferable because of its stronger solvent action. At higher temperatures, the boiling point of this compound makes it impractical because of the loss resulting through volatilization and in such cases dichlor ethyl is preferable. In amounts of solvent up to 30% of the weight of the oil or soap base, complete miscibility is obtained. In higher concentrations, separation occurs and necessitates the use of a mutual solvent to produce a clear homogeneous mixture. Cellosolve and butyl Cellosolve, particularly the latter because of its miscibility with mineral oils, are excellent coupling agents as well as solvents. The method of formulation is simply that of mixing the desired amounts of each material in the absence of water. The mixture emulsifies immediately when poured into water. The quantity of Cellosolve or butyl Cellosolve needed will vary between 10% and 20% of the weight of the mixture. The use of diethylene glycol as a fourth component further enhances the results obtained by imparting desired softness to the scoured material.

The grease and paint solvent properties of these chemicals suggest their possibilities in the scouring of raw wool. Scouring by extraction with a solvent, in our opinion, offers many attractions. Some plants at the present time are employing this system but the majority favor the four or five bowl scouring machine employing soap and an alkali. This system is economical, continuous and efficient. However, a judicious supervision must be exercised over the amounts of alkali used, or harshening of the stock is certain to result. Fluffiness is lost and the stock will lay flat rather than spring. Such a stock is far from desirable. Secondly, impurities such as tar and paint brand marks are not removed by soap solutions, nor by carbonization. Thirdly, the disposal of waste scouring liquors is often a cause of great distress and expense. And lastly, the recovery of the valuable lanolin and wool grease requires a second operation. As compared to an extraction system, all variables of the former are eliminated excepting one, the solvent. Thus, the control of the operation is greatly simplified, and more uniformity of scouring may be obtained. By simple distillation methods the solvent is recovered for reuse as the distillate of the operation, the wool grease, in addition to paint, dirt, and other impurities, remains as the residue.

Such a procedure rather simplifies the complete procedure and solves the problem of waste disposal. The economic features of the two methods are of vital importance, but it would appear that the recovery of the solvent for reuse and the simple recovery of grease would materially lower the scouring cost per pound of wool as compared to the use of soap solutions. Another consideration and perhaps the reason for the general disfavor in which the system is held, is the fact that solvents extract rather too much grease from the stock. A small residue, perhaps 0.5%, seems desirable in preserving the natural softness of the stock. On the other hand, if any harshness has developed, the use of softeners should correct the fault, although the necessity for this small amount of residual grease is a point which perhaps is stressed unduly. Wool stock, before its ultimate purchase by the consumer, is scoured and cleaned many times and the chances that this ½% grease will remain intact are rather speculative. On the other hand, should there be adequate grounds for the belief that harshening occurs, the fact remains that the economies of an extraction system may very possibly counteract this slight disadvantage. As a result, there is offered a fine field for the investigation of such solvents as ethylene dichloride, naphtha, benzol, acetone and others, and their extractive action upon natural wool. Certainly ethylene dichloride possesses valuable properties in connection with ease of recovery, fire-hazard, stability and extraction efficiency.

Of passing interest is the fumigating property of ethylene dichloride and its use in the destruction of insects so harmful to stored raw materials, as well as the finished fabric.

Caution should be used in the use of these chlorinated solvents upon cellulose acetate silk. They are not true solvents but do cause gelatinization. In the

presence of alcohol, they become true solvents.

Butyl Cellosolve is the butyl ether of ethylene glycol—$CH_2OHCH_2OC_4H_9$. It is a colorless, odorless, non-viscous liquid, boiling at 170.6° C., is miscible with mineral oils and soluble in water to the extent of 5 grams in 100 grams of water at 20° C. Its mutual solubility in mineral oils and water make it a valuable coupling material for emulsified products. Butyl Cellosolve is one of the few materials suitable for cleaning Celanese silk. Cellosolve removes the dyes used while the butyl ether has no effect upon them. The high boiling point of the latter is somewhat of a disadvantage as it will not evaporate readily but advantage may be taken of its solubility in naphtha.

In conclusion, it should be stated that at the present time other new chemicals are being thoroughly investigated for possible use in the textile industry. Included in this interesting work are new materials for the degumming of natural silk, dehairing of sheep hides, as well as studies of the adaptability of new chemicals to silk soaking, winding, softening and other similar applications. These subjects have been omitted purposely, but will be considered at a later date as definite data becomes available.

Discussion

Chairman Kingsbury: I am sure Mr. Harvey will be glad to answer any questions you may have.

Mr. Zisman: Do you think that a soap made of triethanolamine with oleic acid, in order words, an oleate of that product, would have the same degumming value as a neutral olive soap, as nearly neutral as it is possible to get?

Mr. Harvey: No. Triethanolamine has a pH of 10.2. In combination with oleic acid naturally that alkalinity is neutralized. This drops the pH to about 8 and a pH of 8 is not high enough to degum silk.

Mr. Zisman: Along that line, of what value would it be to use such a product? Very recently some companies have come out with a degumming product, airing that idea, and claiming certain benefits of course. Naturally, one is interested in degumming of silk. Something else would have to be put in, perhaps some alkali derivative. I mean, do you think there is any particular benefit attached to using such a product, merely for the degumming of silk?

Mr. Harvey: In that connection, I might mention another product which I purposely did not mention because it is only available in small quantities. It is known as monoethanolamine. You might call it a sister to triethanolamine. This material has a pH of 11.6. Its soaps can be made to have any pH that you desire, from neutrality to about 11. We have found by experiment that the use of a certain amount of oleic acid with monoethanolamine will degum silk. But the interesting point is that at the end of the degumming period, whether it be one or two hours, the pH of that degumming bath is the same as it was when it started. In other words, there has been no drop in alkalinity as you will find with neutral olive oil soaps which usually drop to, I believe, from 9 to 8½.

Mr. Zisman: In other words, that would degum faster?

Mr. Harvey: It will hold its pH.

Mr. Zisman: Will it have a less injurious action on the silk?

Mr. Harvey: It will have no less injurious action than another soap which has a pH of 10.

Mr. Zisman: It all depends on the pH?

Mr. Harvey: I think it is a question of pH. I am not a silk man but silk is an animal fiber and other gentlemen this evening have said that silk is not affected in the same way as wool by the presence of alkali. I still believe that over a period of an hour or two, at a boiling temperature, relatively small amounts of alkali will cause bad effects on the silk, and a more neutral soap should be of advantage.

Mr. Zisman: One of the most interesting things I think about the degumming of silk is trying to get something that will degum faster but have no more injurious action and I thought if possible that with the right type of an organic alkali you might get around to that, where it was practically impossible any other way.

Mr. Harvey: That is quite possible and that work as I say has just been started. The material is not being produced in quantity, but I think you will find in the very near future some really definite information.

Mr. Chaky: Has triethanolamine any action on sodium or magnesium stearate?

Mr. Harvey: Triethanolamine itself is an exceedingly weak alkali and will be replaced in any of its compounds by the stronger metals such as sodium, potassium, calcium and magnesium.

Mr. Chaky: The point I want to make is this: We use hard water for dyeing hosiery. At times when the water is excessively hard the soap breaks up, if you are not watching it and it forms calcium or magnesium stearate. We eliminate that afterwards if we get in such trouble by boiling it with an excess of ammonium under higher temperature, and if the spots didn't form into big bulbs we can get rid of them because it pulverizes the sodium stearate and it washes out naturally with water. So in this connection I figured you might have better results if you used the triethanolamine.

Mr. Harvey: I would be inclined to think that monoethanolamine would be the better one. It would have

advantages over ammonia in not being volatile. It is high boiling.

Mr. Chaky: And is there any action on the silk?

Mr. Harvey: No.

Dr. Harold: Can you give me any notion as to what vat colors are soluble in these for example?

Mr. Harvey: I am afraid I cannot give you that.

Dr. Harold: Can't you give me some rough idea of the order of solubility? Is it one per cent or two per cent?

Mr. Harvey: They are completely soluble if you use enough. Of course, I suppose you are interested in just what is enough.

Dr. Harold: I should like to have it expressed in percentage of solubility. That is, could you make it at normal temperatures in 2 per cent solution? That is, would your solvent contain 2 per cent of dye dissolved or 3 per cent or just how much?

Mr. Harvey: I would say, roughly, an equal weight of solvent as compared to dry powder dyestuff. That is, if you were using a paste that was only 20 per cent dry powder you would use an amount equivalent to that dry powder base.

Dr. Harold: I don't mean for a mere suspension or dispersion. I understood you to say that some of these dyes that you mentioned—you mentioned particularly the acid and the basic colors and basic lakes as you called them—were soluble. I thought you meant soluble rather than merely dispersible. If they be soluble, would 100 c.c. of such a solvent dissolve, say, 5 grams of the dyestuff or one gram, or—

Mr. Harvey: It will depend entirely on the dyestuff. I mentioned the vat colors which seem to be about equal weight of solvent on dry powder. With basic it will probably take 4 or 5 times the weight.

Dr. Harold: Do I understand you to mean that you might get from a 20 per cent solution up to a 50 per cent of dyestuff in these liquids?

Mr. Harvey: Yes.

Dr. Harold: That is remarkable.

Mr. Hadley: What would be the effect of these solvents on a dyed fabric if you wanted to strip the color out? Would the solubility still be exerted toward the dye on the fabric? For instance, if you got a color that you wanted to strip, or for some reason it had gone on unevenly, or you wanted to change over and have your fabric dyed with a lighter color where a dark color had been on, would the solvent action still be there?

Mr. Harvey: To a certain extent but very noticeably less.

Mr. Sokolinski: On those samples of yarn you passed around, was that lubricated with straight olive oil?

Mr. Harvey: Olive oil emulsion.

Mr. Sokolinski: The shade of it would depend I should say to a considerable degree on the emulsifier that was used, to start with. I mean, you may have an emulsifier there that is alkaline. Say, for instance, you had borax or something like that. That may have a tendency to discolor the wool. Was your diethylene glycol the same strength as your olive oil?

Mr. Harvey: Exactly the same weight of diethylene glycol as olive oil in the emulsion.

Mr. Sokolinski: That may have some bearing on why the yarn is discolored.

Mr. Harvey: I rather think it is the oxidation of the oil. As you know, practically all oils are unsaturated, which means that they will oxidize. Olive oil is perhaps an offender to a small degree than most others. But olive oil will still oxidize over a period of time. As I said, this yarn has been aged for six months. In other words, it has been given plenty of time to oxidize if it is going to.

Mr. Sokolinski: Isn't it true that certain types of emulsifying agents have material in them that will decrease the oxidation of the oil?

Mr. Harvey: Yes, that is true.

Mr. Sokolinski: When you speak of red oil and spontaneous combustion, do you mean the lubrication with straight red oil?

Mr. Harvey: If you apply it in emulsion. Of course, your water evaporates and you get back to oleic acid, red oil, and a small amount of soap, or whatever has been used.

Mr. Sokolinski: Isn't it true that your red oil is there in a very, very small degree, I mean, if it is used properly?

Mr. Harvey: On wool, depending on the grade of wool, they will go up as high as 15 per cent on the weight of the wool.

Mr. Sokolinski: But then you have your other oils in combination with your red oil?

Mr. Harvey: I have seen a great deal of lubricating with straight red oil, yes, indeed—and they have fires about once a week. (Laughter)

Mr. Sokolinski: Then they ought to change. (Laughter)

Mr. Hadley: What are going to be the chances of these organic solvents replacing the mineral solvents used in dry cleaning?

Mr. Harvey: That is a point I didn't mention. I should have.

In dry cleaning up to the present, I think the general policy was to use only about one per cent soap in naphtha with a very small amount of water which increases the detergent properties of the soap that is there. The tendency now seems to be to increase this amount of soap up to around five per cent. To make a soap soluble in naphtha free oleic acid or free fatty acid is necessary. That is, the saponified neutral soap will not be soluble.

Trienthanolamine is decidedly less alkaline than sodium or potassium hydroxide. Consequently, the soap itself is decidedly more soluble in naphtha. In fact, a totally saponified oleic acid using triethanolamine is soluble. It is not soluble under about three per cent, and it is less soluble if a small amount of water, say, for instance, ten per cent of the weight of the soap, is used. By using butyl Cellosolve, that soap still containing ten per cent of its weight of water is infinitely soluble. That is, butyl Cellosolve acts as a coupling agent and puts the water and soap in a complete solution down to very small fractions of one per cent.

Mr. Hadley: I may be absolutely off in my conception of what these organic solvents are in their physical condition but what I had in mind was this: the dry cleaner uses a compound which appears to me to be a cross between a gasoline and a kerosene. As far as inflammability goes, you can put a match on them and they won't be affected. I have seen them in what would be really a laundry-wheel, and within a distance of ten or fifteen feet I have seen two or three tiers of oilers with an open fire going in them, and in another room within ten or fifteen feet I have seen these laundry-wheels with this what I call a cross between kerosene and naphtha there. There must be some fumes coming from them, but they seem to be perfectly safe.

The dry cleaners have told me that in the past they used a straight naphtha and they had a lot of fires and explosions. They do not have that trouble with this new compound.

The Standard Oil and the different oil companies are putting out this compound.

What I had in mind when I asked this question was to find out whether these solvents are going to be used for any such purpose as that. The only one I am personally acquainted with that might be used for dry cleaning purposes is a compound of the nature of carbon tetrachloride. I know what carbon tetrachloride is, having handled it. The others I am not familiar with.

Mr. Harvey: The only one I have mentioned this evening that would be at all applicable is ethylene dichloride which is very similar to carbon tetrachloride.

Mr. Hadley: Is that as heavy as carbon tetrachloride?

Mr. Harvey: No.

Mr. Hadley: Where is the evaporation?

Mr. Harvey: That is a bad point. It is not a high boiling material.

Mr. Hadley: So it would be apt to remain back in the material?

Mr. Harvey: You would lose more by evaporation in using it as a general solvent. Being a low boiling material, during the course of your cleaning it will volatilize.

Mr. Hadley: Would that volatilize without leaving a residue?

Mr. Harvey: Yes. And its stability is important. But personally I don't think I would recommend that as a dry cleaning solvent in place of naphtha. Of course, it has an advantage in being non-inflammable. That is, it is hard to burn. It will burn if you try hard enough.

Mr. Hadley: Does it volatilize at a point below naphtha?

Mr. Harvey: Dry cleaners' naphthas are extremely high boiling, going anywhere from 200 degrees centigrade to 300. They are a distinct type of gasoline, of a very high boiling character. The reason for that of course is to eliminate any loss from evaporation.

Mr. Chaky: Which one evaporates faster, diethylene glycol or sulphonated castor oil? I mean, which one evaporates in bigger volume?

Mr. Harvey: I have no idea what the boiling point of sulphonated castor oil is but diethylene glycol is extremely high, 245 degrees centigrade.

Mr. Chaky: What I mean is this: sulphonated castor oil is used on some rayon goods to give them a softer feel. If it evaporates and it is dried at 200 degrees Fahrenheit, naturally there must be a certain percentage evaporated, and if the diethylene evaporates in a smaller percentage that means you have to use less diethylene or an equal amount.

Mr. Harvey: You will find, I think, that diethylene glycol is decidedly less volatile. You will not lose as much.

Mr. Chaky: I have tried diethylene glycol and it was satisfactory in that respect. I wanted to know exactly what the savings were.

Mr. Harvey: Two hundred and forty-five degrees centigrade shows that you will lose very little at 200 degrees Fahrenheit.

Mr. Chaky: At 200 it is still less.

Mr. Harvey: Yes.

There is one point I would like to mention in considering diethylene glycol as a softener. Softening is really attributed to some fatty body, to an oil or a grease. That is, tallow and the different vegetable oils all have softening ability but mineral oil does not have softening ability. Diethylene glycol is an alcohol and an ether and that does not have softening body either and I have never found that diethylene glycol by itself is an actual softener. There is no fatty body there and there is no reason to expect that it should be a good softener by itself but being a very strong penetrant and having the ability to carry softening oils and fats, whatever they may be, into the fibers and yarns there is a decided softness obtained. This is also due to its conditioning action, or hygroscopicity. But as a softener simply by itself I doubt if you will find anything at all.

Mr. Chaky: I have found it was more hygroscopic than glycerin.

Mr. Harvey: Yes.

Mr. Chaky: Naturally it is not to such an extent that it should make rayon too much weaker. It all depends on how much you use. (Applause)

Chairman Kingsbury: If there is no further business a motion to adjourn is in order.

. . . . The meeting adjourned at ten o'clock.

SIXTY-THIRD COUNCIL MEETING
March 21, 1930

THE SIXTY-THIRD Council Meeting of the American Association of Textile Chemists and Colorists was held at a luncheon of the Chemists Club, New York, N. Y., at 12:30 Friday afternoon, March 21, 1930.

The following officers and councillors were present:

President: E. H. Killheffer.

Vice-Presidents: W. S. Williams, P. J. Wood.

Councillors: Wm. R. Moorhouse, Walter M. Scott.

Councillors (ex-officio): Wm. H. Cady, Chairman, Northern New England Section; P. F. Kingsbury, Chairman, New York Section; A. M. Burtt, Chairman, Philadelphia Section; Prof. L. A. Olney, Chairman, Research Committee.

Secretary: Alex. Morrison.

The following telegram was received from Councillor Hugh Christison: "Regret inability to attend this and last several meetings of Council. Certainly expect to do better."

The reading of the Secretary's report of the last Council Meeting was waived.

The Financial Report of the Secretary was read as follows, and approved:

Financial Report of Secretary—March 19, 1930

Cash on hand Andover National Bank 2/13/30..	$246.44
Receipts 2/14/30 to 3/19/30, inclusive:	
Applications (24 @ $5.00).....	120.00
1930 Dues (72 @ $5.00).....	360.00
New Corporate Member.....	25.00
1930 Corporate Dues.....	25.00
Atlas Electric Devices Co. Royalties.....	44.00
Howes Publishing Co. (Reporters).....	15.00
Misc. Sales	4.00
Fastness to Light Reports.....	19.22
2 Pins	3.00
1 Year Book.....	3.00
	$864.66
Disbursements:	
3/12/30 to Treasurer—Research Fund....	$101.82
3/12/30 to Treasurer—General Fund.....	350.00
2/15/30 Exchange Charge.....	.15
3/3/30 Exchange Charge.....	.25
Cash on hand Andover National Bank 3/19/30..	412.44
	$864.66

The following were elected to membership:

Active

Clarke, George D., Hopkinton, Mass. Dyer, Seamans & Cobb Thd. Mills., Hopkinton, Mass.

Platt, Herbert, 823 Gephart Drive, Cumberland, Md. Supt. dyeing dept., Celanese Corp. of America, Cumberland, Md.

Rutter, Earle R., 64 Haverhill St., Andover, Mass. Overseer of dyeing, Lower Pacific Mills, Worsted Div., Lawrence, Mass.

Vaughn, Gideon A., 57 Fairview St., Denim, Greensboro, N. C. Overseer of indigo dyeing, Proximity Print Works, Greensboro, N. C.

Junior

Casey, Francis H., 50 Penfield St., Roslindale, Mass. Student, Lowell Textile Institute, Lowell, Mass.

Haney, Marcus D., Jr., 7 West 10th St., Charlotte, N. C. Color chemist, DuPont Laboratories, Charlotte, N. C.

McGregor, James T., Jr., Apt. 118, Wellon's Apartments, Charlotte, N. C. Demonstrator, E. I. duPont de Nemours & Co., 232 West First St., Charlotte, N. C.

Shimp, Richard A., 44 Zeigler Tract, Penns Grove, N. J. Colorist, E. I. duPont de Nemours & Co., P. O. Box 518, Wilmington, Del.

Wedler, Fred C., Jr., 800 Kenilworth Ave., Charlotte, N. C. Chemist in color laboratory, E. I. duPont de Nemours & Co., 232 West 1st St., Charlotte. N. C.

Corporate

Lever Brothers Company, 164 Broadway, Cambridge, Mass. W. A. Boucher, 164 Broadway, Cambridge, Mass.

The following was elected subject to receipt of check to replace one returned to him as the bank had been reported as closed:

Junior

Gregg, L. A., The Holmes Apts., Charlotte, N. C., Demonstrator, DuPont Dye Stuff Co., 232 W. 1st St., Charlotte, N. C.

The following were elected to membership as of April 3rd, 1930, a date thirty days after their names were published, provided no objections are received to any of them by the Secretary before then:

Active

Balloch, James, 971 Harrison St., Philadelphia, Pa. Dyer, Delta Finishing Co., Lewis and Ashland Sts., Philadelphia, Pa.

Broom, Arnott R., 5311 N. 13th St., Philadelphia, Pa. Manager and chemist, Jos. R. Foster & Sons, 2nd and Clearfield Sts., Philadelphia, Pa.

Bruce, Robert A., 945 Herbert St., Frankford, Philadelphia, Pa. Dyer and chemist, Horrocks & Bros., Adams and Unity Sts., Frankford, Philadelphia, Pa.

Gass, James K., 603 Levick St., Philadelphia, Pa. Supt. of dyeing, Stead & Miller, 2611 No. Bodine St., Philadelphia, Pa.

Haines, Millard E., 4021 Magee St., Tacony, Philadelphia, Pa. Dyer, Globe Dye Works, 4520 Worth St., Frankford, Philadelphia, Pa.

Hunter, Hill, 900 Carolina St., Greensboro, N. C. Pur. agent, Proximity Mfg. Co., Greensboro, N. C.

Miller, H. S., "Brookdale," Statesville, N. C. Overseer of dyeing, Statesville Cotton Mills, Statesville, N. C.

Soutar, James H., 384 Broadway, Lawrence, Mass. Dyer, Pacific Mills, Worsted Div., Lawrence, Mass.

Sullivan, Robert E., 343 E. Gorgas Lane, Germantown, Philadelphia, Pa. Chemist, The Stead & Miller, 2611 No. Bodine St., Philadelphia, Pa.

Waters, Daniel F., Jr., 607 East Allens Lane, Mt. Airy, Philadelphia, Pa. Dyer, Germantown Dye Works, 53 Wister St., Germantown, Philadelphia, Pa.

The following were elected to membership as of April 17th, 1930, a date thirty days after their names were published, provided no objections are received to any of them by the Secretary before then:

Active

Perry, Edward T., 92 Main St., Lonsdale, R. I. Asst. chemist, Lincoln Bleachery & Dyeworks, Lonsdale, R. I.

Tillinghast, Edward S., Chemist and asst. mgr., Fairforest Finishing Co., Spartanburg, S. C.

Junior

Covington, R. M., 542 South Crest Road, Chattanooga, Tenn. Salesman-demonstrator, DuPont Co., 715 Provident Bldg., Chattanooga, Tenn.

Jones, Bliss M., 87 Hancock St., Lexington, Mass. Student, Lowell Textile Institute, Lowell, Mass.

Richardson, Hiram L., P. O. Box 44, West Chelmsford, Mass. Laboratory asst., Lowell Bleachery, Lowell, Mass.

Three applications were referred back to the Secretary for further investigation.

The President announced the appointment of the Committee from our membership to invite similar committees from other associations to formulate plans for Research Bureau in accordance with vote taken at our last Annual Meeting, and in accordance with vote passed at the Council Meeting, February 14th, 1930. The Committee to be known as Research Conference Committee is as follows:

P. J. Wood, *Chairman*
Joseph F. X. Harold
Walter M. Scott
William H. Cady.

The President announced that for this Committee he had already sent out invitations to a large number of associations, etc., to appoint their committee, and meet with ours, and had replies from several. The last of these invitations were sent out March 14th, 1930.

In connection with this matter a letter from the Textile Research Council, dated March 17th, 1930, and signed by its President, George Gilmore, was read, in which our Association was invited to appoint a committee of three to meet under the auspices of the Textile Research Council with similar committees from other associations in Boston, Mass., April 30th, 1930, at 10:30 A. M., for the purpose of discussing plans for a general Research Council.

The President was authorized to acknowledge Mr. Gilmore's letter and to appoint a Committee to attend this meeting, soliciting permission to send the whole of the Research Conference Committee.

The Program Committee for the next Annual Meeting to be held in Chattanooga, December 5th and 6th was elected as follows:

W. S. Williams, *Chairman*
Joseph F. X. Harold
Henry F. Herrmann.

The following remarks of R. M. Mitchell, Chairman of the Piedmont Section made at the Quarterly Meeting of that Section January 25th, 1930, was brought to the Council's attention:

—"Fourth is a matter which has been brought to my attention by several members. It has to do with the idea of getting more representation in the Association Council. Increased prestige and representation will insure a larger and more active membership, and when the time comes, which will be in the near future, I trust the Section will be granted the added recognition"—

It was voted the following open letter be sent to the Chairman and Secretary of the Piedmont Section:

R. M. Mitchell, Chairman,
A. R. Thompson, Jr., Secretary,
Piedmont Section.

Gentlemen:

The report of the Quarterly Meeting of the Piedmont Section held at Greensboro, N. C., January 25th, 1930, has been brought to the Council's attention, particularly the remarks made by Mr. Mitchell in regard to getting more representation on the Association Council.

The Council feels that the Southern members should get a true picture of this situation.

The Southern Section was organized September 26th, 1924, and was split into the Piedmont and South Central Sections April 30th, 1927.

The Southern Section, and Piedmont Section which succeeded part of it, has had six different Chairmen including the present incumbent. By virtue of his office, the Chairman is a member of the Council. According to the records, with the exception of the Council Meeting

held in Charlotte, N. C., December 3rd, 1926, at the time of the Annual Meeting held there, and the Council Meeting held in Providence, R. I., December 6th, 1928, at the time of the Annual Meeting, the Chairman of the Southern, Piedmont, and to be exact the South Central Section, has never attended a Council Meeting.

In the first case, L. S. Little, then Chairman, was present, and in the second case Prof. Chas. E. Mullen, then Chairman, was present.

Furthermore, in December, 1927, B. S. Phetteplace was elected to the Council and according to the records has not been present at any meeting.

Furthermore, at the Council Meeting, December 6th, 1929, it was voted that if a Chairman of a Section was unable to be present at any Council Meeting, he could appoint a representative, and to date no representative has been sent.

Since the formation of the Southern Section there have been 38 Council Meetings. Since the election of the Councillors from the South, there have been 14 Council Meetings. And since the vote of the Council to permit a Chairman to send a representative there have been two council meetings.

In fairness to busy and interested men of the South, we wish to state that we were very pleased and honored to have Messrs. H. A. Barnes and H. M. Chase present at the special Committee Meeting on the Research Bureau held in New York, November 8th, 1929.

It would appear to the Council that the Piedmont Section has had plenty of opportunities to be represented at the meetings, but have availed themselves of very few of these opportunities.

The Piedmont Section has 125 members more or less, and the South Central 60 members more or less, and there are about 1300 members in the Association. That is, about 14.2 per cent belong to the two Southern Sections. The whole Council consists of 19 and the Southern Sections have three members of this body, or 15.8 per cent.

Therefore it would appear that potentially the Southern Sections are properly represented in the Council.

Mr. Phetteplace's term as Councillor expires next December, and we would suggest that your Section look around for a man to take his place who would be in a position to attend the meetings more easily. This is in no way a reflection on Mr. Phetteplace's interest in the Association, but evidently the times and places of the Council Meetings do not fit into his schedule.

Please understand that we are not taking an antagonistic stand in this matter, but only feel that you and the members should know all the facts.

Respectfully yours,
For the Council,
ALEX. MORRISON, Secretary

The matter of appointment of Assistant to Research Associate, laid on the table at last meeting, was taken up and was indefinitely postponed.

A letter from the Smithsonian Institute asking if our Association could prepare an exhibit showing dyestuffs in the various stages of manufacture, and various stages of application was read. Walter M. Scott was instructed to investigate just what was wanted and report back at a later meeting.

An inquiry from R. S. Wheeler, Chairman, South Central Section, in regard to engaging a stenographer to report meetings, was read and it was voted that the Association would pay such bills, but that as far as possible the speaker should read a prepared paper, a copy of which the Section could have, thus insuring correct copies and cutting expense of reporting.

The Council Meeting adjourned at 2:45 P. M. until April 30, 1930.

Respectfully submitted,
ALEX. MORRISON, *Secretary.*

FIFTY-EIGHTH RESEARCH COMMITTEE MEETING, MARCH 21, 1930

THE Fifty-Eighth Meeting of the Research Committee of the American Association of Textile Chemists and Colorists was held at the Chemists' Club, New York, N. Y., at 2:45 P. M., Friday, March 21, 1930.

The following were present:

L. A. Olney, *Chairman*
Donald S. Ashbrooke
Wm. D. Appel
A. M. Burt
Wm. H. Cady
Harold D. Clayton
Carl S. Draves
(representing R. E. Rose)
Walter C. Durfee
Walter E. Hadley
Jos. F. X. Harold
Arthur E. Hirst
P. F. Kingsbury
Edw. F. L. Lotte
Hans Meyer
Wm. R. Moorhouse
Walter M. Scott
P. J. Wood
Alex. Morrison, *Secretary*

The Chairman asked for ideas to be incorporated into the Year Book, and invited general discussion of the present features and arrangements. It was voted to standardize on the following signs and abbreviations in the reports of the various sub-com-

mittees: to uses the sign for per cent, as %, instead of the word; to use sign for degrees, as °, instead of the word; in mentioning temperatures to use °C. as the standard reading followed by the °F. in parenthesis, as 100° C. (212° F.); in mentioning gravities to use degrees Twaddle, as 10° Tw., instead of specific gravity or degrees Beaumé.

It was also voted that in the Tabulation of the American Dyes in the Year Book to give only Color Index numbers, omitting the Schultz numbers, but to publish a list of Colour Index Numbers into Schultz Numbers as formerly.

The personnel of the Rayon Sub-Committee was again given consideration, the Chairman of the Research Committee having been unable to enlist the services of any of the men mentioned at the last meeting as Chairman of this sub-committee. Further names of men were suggested to be approached by the Chairman.

The rest of the meeting was given over to the reading of reports from the various sub-committee Chairmen sent in at the request of the Chairman, in which they reported progress of work in hand, and made suggestions for future research along their respective lines. These reports were discussed and enlarged upon to some extent by the various committee men present. From these reports the Chairman hopes to be able to draw up a definite program for future work.

In connection with some of the present research, Prof. Olney read a letter he has sent to the Bureau of Standards outlining proposed work of our Research Associate, Wm. C. Smith, requesting permission from the Bureau to allow him to remain at the Lowell Textile Institute for a while longer in order that he could finish some work he is doing for committees whose chairmen are located in the vicinity of Lowell, in order that consultations could be arranged more easily.

Mr. Appel reported for the Bureau that this permission was forthcoming, although the actual letter had not been sent due to pressure of other business.

Mr. Cady, Chairman of the sub-committee on Light Fastness, discussed the paper by Dr. Paul Krais of Germany and after consultation with his committee will send a reply in accordance with instructions given him at the last Research Committee Meeting.

Wm. D. Appel, Chairman of the sub-committee on Research Survey, reported progress for his committee and at a future meeting will present a diagrammatical plan of the field of textile research.

The meeting adjourned at 5:15 P. M. until April 30, 1930, at Boston, Mass.

Respectfully submitted,
Alex. Morrison,
Secretary.

APPLICANTS FOR MEMBERSHIP

Active Membership

Braham, Chester M., manufacturer of textile chemicals, Arkansas Co., Inc., 233 Broadway, New York, N. Y. Sponsors: Alex Morrison and W. M. Sullivan.

Healy, Jr., John J., chemical engineer, Merrimac Chemical Co., Inc., 148 Stone St., Boston, Mass. Sponsors: F. J. Curtis and H. C. Chapin.

McCarthy, Justin J., sales department, Merrimac Chemical Co., Inc., 148 State St., Boston, Mass. Sponsors: F. J. Curtis and H. C. Chapin.

Purvis, Fred H., dyer, S. Slater & Sons, Webster, Mass. Sponsors: Wm. H. Cady and Nelson Barlow.

Ramm, Dr. Marie S., chemist, Arnold Print Works, North Adams, Mass. Sponsors: Denis de Geonoz and Albert S. Jones.

Serra, Dominick R., head dyer, Pohatcong Hosiery Mills, Washington, N. J. Sponsors: Henry F. Herrmann and Percival Miller.

Wielenga, Andrew, foreman finisher, Oriental Silk Printing Co., Haledon, N. J. Sponsors: P. J. Wood and C. F. Hoppe.

Junior Membership

Audette, Romeo J., foreman dyer, Fall River Bleachery, Fall River, Mass. Sponsors: K. Malcom Grinnell and Frank E. Arnzen.

Haar, Lawrence F., student, North Carolina State College, Raleigh, N. C. Sponsors: A. H. Grimshaw and W. F. Isom.

Purcell, Eugene, student, North Carolina State College, Raleigh, N. C. Sponsors: A. H. Grimshaw and W. F. Isom.

Schmottlach, William Ed., dyer, Farwell Bleachery, 50 Canal St., Lawrence, Mass. Sponsors: Chas. L. Howarth and Chester A. Amick.

Tarshis, Elias A., assistant dyer, Pohatcong Hosiery Co., Washington, N. J. Sponsors: Henry F. Herrmann and Percival Miller.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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STATISTICAL TRIBUTE

CERTAINLY there is cause for congratulation in the preliminary report of the United States Tariff Commission covering the Census of Dyes for the year 1929. An industry which less than two decades ago was struggling against powerful and seemingly unrelentless foreign competition has gradually evolved into a conspicuously successful world factor. The transition was stimulated to a very great extent by the emergencies created during the Great War. America then was faced with not only the possible but the probable embargo of all dyestuffs originating in foreign countries. She was obliged to muster forces to meet this situation almost over night, as it were. From then on the whole story runs very much like that of the child who was best instructed in the art of swimming by being thrust into deep water.

When the country returned to a state more nearly resembling normalcy following the years of hostilities, it found that the facilities and the ability were here present to permit even a more active and healthy competition with foreign markets than ever before thought feasible. Each successive year registered very distinct progress. The output of the elementary dyes increased manyfold; tremendous strides were made through the tireless and constant efforts of those in research towards the production of fast dyes that would stand up under the most severe tests.

In 1929 another series of impressive records was established. The domestic production by quantity of coal-tar dyes exceeded that of any previous year, according to these advanced statistics. This figure was approximately 110,200,000 pounds, an increase of 13,570,000 pounds or 14 per cent over production in 1928. The vat dye production alone rose from slightly over 6,000,000 pounds in 1928 to more than 9,000,000 pounds in 1929.

It appears that the imports of coal-tar dyes last year were by quantity only about 8 per cent of apparent consumption, assuming this consumption to be equivalent to sales plus imports minus exports. Therefore, judging by the estimate, the production in this country was able to supply practically 92 per cent of the requirements of the United States. In addition to this, it is also rather interesting to note that, according to value scales, the domestic dyes attained a figure of about 80 per cent of consumption, basing this conclusion on the supposition that it is equal to sales plus duty paid value of imports less the exports themselves.

Both the figures for quantity and value exportation of coal-tar dyes in 1929 were considerably in excess of those in the previous year. The quantity went from a little less than 28,000,000 pounds in 1928 to 34,000,000 pounds in 1929, and the value from approximately $6,000,000 to $7,250,000 in the latter year. It is perhaps significant to note that the exports, according to the information provided by the Government, consist principally of indigo, sulphur black, and the low priced bulk dyes.

So the country may well be proud of her young industry which is forging ahead in a manner to attract the attention and the respect of the whole world.

THE NEW SPIRIT IN RESEARCH

RESEARCH is considered the backbone of advance in any line where there are constantly changing demands and standards. Industry after industry is becoming aware of this fact and units inside the various industries themselves are gaining forces to make specific efforts towards the establishment of divisions where the puzzling and complex problems, which are forever appearing, may be studied and successfully met. Each trade as it realizes the fundamental importance which is attached to this new and all-embracing development discovers that the investment, while it may be with no tangible results at first, finally brings returns which more than compensate for the additional outlay.

The Government is taking a leading part in all this through the medium of the tremendously valuable work that is being carried forward day after day, month after month, by the competent staff in the Bureau of Standards at Washington. The Department of Agriculture, as well, is cooperating importantly in this essential movement by means of its constant research endeavors for the betterment and welfare of that vast field which comes under its immediate supervision. Meanwhile, scientific research throughout the entire country is being prosecuted by numberless industries, thereby making significant increases to the already valuable fund of information at hand.

One does not often realize that the spirit which is enabling the United States to forge ahead in the matter of industrial expansion and prosperity is a far cry from that which characterized that of the last century. At that time discoveries were made, but these came very largely not as a product of scientific research but as the result of rather haphazard accumulation of practical facts. And still more important, when a new departure was brought to light, its secret was zealously guarded by the individual or small group to whom its potential power was known, the thought of general advantage to the trade, through dissemination of facts of value to all not having yet evolved. But today a different spirit is in vogue. This spirit is constantly reflected in the willingness of competitive organizations in a given industry to pool, without any disadvantage to themselves, certain common resources to their mutual profit.

The textile industry has as great a need as any other group for the establishment of some definite research organization. True enough, there have been several efforts made during the past few years to create such a central organization serving every branch and unit of the industry. Yet, for one reason or another, most of such efforts have lacked the wholehearted support of those whose cooperation was essential.

This past winter has seen another proposal. The A.A.T.C.C. at its annual meeting, by unanimous vote, appointed a committee to investigate ways and means for bringing a plan on this order to fruition. This group has extended invitations to similar associations interested in fundamental research in the textile industry to delegate men to work with them towards this common end. The response has been immediate, and meetings have been held to determine upon definite procedure.

This new move has been initiated with the firm conviction that this central bureau, once established, can become a powerful factor in the betterment of every division of the entire industry. It can succeed in its aim provided that all will give not merely assent, but cooperate, this aiding in the attainment of a common goal. It is a challenge to every man in the textile industry to see that his branch responds. It calls for more than a passing voice of approval in the abstract. It demands immediate and concrete action.

Random Thoughts on Research

Can Textile Research Be Completely Centralized?

CAN an effective research association be planned that will take up all kinds of textiles? This is a fair question which may be extremely important to the success of any future undertaking.

From the research point of view, it is an excellent idea to have one big organization. It would save much duplication of libraries, information files, rent and office expense, and such details; make possible economies due to a smaller staff of directors than would be required if there were a number of smaller institutions instead; and, quite likely, save much actual duplication of work. The greatest advantage would be in the close personal contacts of men working on a great variety of textile problems.

The first difficulty would arise in trying to apportion the work. There would be only one fair basis that would be at all practicable. Each donor of yearly income or endowment would have to specify the fibers on which he wished it spent, and the research institute would have to plan accordingly. This might have a cramping influence at times, but is not an unsurmountable difficulty.

A real difficulty probably would arise in the fact that the common fibers are to an extent competing with each other, especially in certain price ranges that fall between them—between cotton and wool blankets for example. It would be the easiest thing in the world for a contributor interested in silk to get the idea that the institute was promoting work which might tend to bring rayon into competition with his particular line of business. It might not be true at all but there would be a feeling of dissatisfaction just the same, and possible withdrawal of support. This may sound petty, but it would not take very many such experiences to seriously attract affect the success, if not the very life of the research.

We can easily see that some of the work outlined in earlier installments, such as the general literature review; the publication of the known facts about all textiles; and the tentative standards for mill operations, tests, etc., could be carried out by a centralized group, and probably to advantage. Duplicates of all material would be available for smaller associations that might be formed later.

The actual experimental work seems to be another matter. It seems almost certain that results or publications emanating from any central source would soon be subject to the kind of criticism described.

On the other hand, if there are separate groups each working on its own main fiber, and having reference to the others only where necessary to the business or to particular research problems, each can report or publish as it pleases.

A cotton research association might show cotton men how to displace some wool and thus seem very successful. Then the wool men's work would put wool back where it was really best, and perhaps displace some cotton somewhere else.

This healthy competition would tend ultimately to put cotton where it is of most value, wool where it is best adapted and so on through the list, but any changes made would be on the basis of fair competition and no chance or suspicion of favoritism.

Technical Notes from Foreign Sources

Determination of Fastness to Light with the Quartz (Ultra-violet) Lamp

Dr. R. Lasse—Mell. Textil-Ber. 10, 618 (1929).—Determination of the fastness to light of dyed textiles is associated with many difficulties. Not only does the alteration in intensity of the sunlight have a strong influence upon the tests, but also the alterations of the substratum, altered from its original color, in combination with the dyestuff remaining after a light-fastness test, often gives rise to false conclusions in judging the fastness of the actual dyeing. This alteration of the substratum is most serious when we use as a light-source a quartz mercury-vapor arc-lamp, such as the Hanau type, now so much used in laboratories for different purposes. Wool is the fiber which is most subject to yellowing, even after a reasonably short exposure to light. This fact may be well observed, if wool weakly dyed with Patent Blue V is tested for fastness under the quartz lamp and in sunlight. The dyestuff is indeed bleached in each case, but the yellowing, or more strictly the partial combustion of the wool, which the ultra-violet rays of the mercury arc brings about, leaves the residual color of the wool a greenish-yellow, while the samples exposed to sunlight show this yellowing in only slight degree. The characteristic odor of "burnt hair," which is detectible after a short irradiation under the lamp, shows that a deep-seated alteration of the wool-substance is going on. The practical dyer is therefore often forced to test the light-fastness of those dyes which he has to use upon wool, upon some other substratum, in order to form a decision quickly and surely. In what follows the author describes a method of testing light-fastness, much employed in practical work, a method which avoids the disadvantages mentioned, without, to be sure, being able to assert that the method meets the conditions of lighting to which the goods dyed with the dyestuffs tested must be exposed.

The viewpoint that only dyestuffs and not dyeings should be tested is to a certain extent justified, when one considers that a dyestuff in the form of an acid or basic wool-dyeing is physically and chemically somewhat other than in its original condition. It has, however, been proved that the light-fastness properties of the dyestuff stand in a direct relation to the dyeings produced with the dyestuff; that is, that a dyestuff which by itself is not fast to light also possess poor light-fastness when dyed, and conversely. Naturally, there is a possibility that with the enormous number of organic dyestuffs now known a single one may exist, whose behavior under the mercury arc will give different results than were to be expected. Thus, in the determination of the "absolute light-fastness" of Flavazine E3GL, as we may call the fastness of the dyestuff to light in contrast to the fastness of its dyeings, it appeared that the shade of the dyestuff became under certain conditions redder and deeper, when irradiated under the quartz lamp, while by the ordinary method of testing, in sunlight, such an alteration could not be perceived. But these phenomena are, in the acid dyestuffs, to be reckoned only as exceptions. So, the determination of the absolute fastness to light of basic dyestuffs offers no difficulties, if we keep within the limits mentioned below. The chief advantage of the method, of course, lies in the speed with which it can be carried out, making unnecessary troublesome trial dyeings and long exposures in uncertain weather. The fastness to light of a dyeing is one of the most important requisites met with today, perhaps in some degree even surpassing the demand for a high degree of fastness to washing. The Indanthrene dyestuffs leave nothing to be desired in some respects, but their price, their impossibility of being applied (up to the present) for certain types of dyeing, their failure to yield tones of great depth combined with brilliancy, forbid their use in all cases, though here it is of course not a question of fastness to light.

As a substratum, the author has up to the present found porous clay plates to be the most suitable; those plates which play so large a part in the rapid drying of precipitates, etc., in chemical laboratories. If plates are not available, flat fragments of unglazed clay dishes (such as are used for the same purpose), the flat middle parts, can be used. Care must be taken in any case that a large, uniform stock is on hand, for the material is naturally far from the ideal white, and one has to get used to the fundamental tint before accurate results can be hoped for. Plates of a size 15 x 15 x .8 cm. are convenient. Upon these clean clay plates (cleaned by use of a good rubber eraser) a field-graduation is drawn with draughting-ink. Drawing upon the porous plate is possible with reasonable satisfaction only if we use a draughting-pen adjusted for a very fine line, and draw the lines very rapidly. Lead-pencil, which would be more convenient to use, since a running together of the lines is not to be feared, cannot be recommended, since in putting on the dyestuff solution later on the lead-pencil marks are rubbed off, and may give rise to dirty smearings in the coloring of the plate. In most cases, a coating with a solution of 1 g. of dyestuff in 100 cc. of distilled water has proved to be most satisfactory. In the case of some basic dyestuffs, such as Methylene Blue B, which gives unusually intense coloration, it is better to work with considerably more dilute solutions, although too low concentrations make the production of an even coating or tinting upon the porous

plates more difficult. By the use of a solution of the ratio 1:500 it should be possible to get goods results. The limits of the concentration depend upon the solubility of the dyestuff. According to the procedure mentioned, up to as many as 15 dyestuffs were tinted upon one porous plate, and were irradiated in such a manner that all the dyestuffs in the same test were exposed for different periods to the influence of the ultra-violet radiation. Before the irradiation, the clay plates with the color-tints must be dried over night. If this is not done, it may easily occur that spots form upon those parts of the plate which are shielded from the exposure. Then, too, the prepared plate is to be protected from being splashed or sprayed with water, since the dye-poor or dyeless spots so formed may make the results of the test of only questionable decisiveness.

The irradiation itself was carried out thus: all of the sample-plates were exposed at a distance of 30 cm. from the arc-lamp, of course without interposition of any filters, for various time-intervals. For convenience, the inner surface of the lamp-housing was used as establishing the distance of the plates from the light-source. For tests upon larger samples, as for tests in which the distance from the light-source is to be varied considerably, the window at the back of the lamp can well be used. In testing dyeings upon wool, greater distances hardly come into consideration, since the intensity of the irradiation would be greatly diminished and prolonged exposure would be necessary. Especially would the distance have to be considerable, in order to make impossible the phenomena of scorching of the wool.

A cut is given, in the original, of a specimen plate, which was tinted with fifteen dyestuffs, in parallel vertical strips. The plate was first divided by vertical lines of draughting ink into fifteen columns, and by horizontal lines into five spaces, the uppermost of which was narrow, carrying the successive numbers of the columns; the remainder of the space being divided into four equal spaces. Of these four horizontal spacings, the uppermost is kept covered throughout the irradiation, the next is exposed four, the next eight, and the last twelve hours. Each vertical column therefore shows the dyestuffs in question as non-faded, and as variously affected during chosen periods of exposure.

The following table gives the results for the dyestuffs chosen, as to their absolute fastness to light determined by the clay-plate method, their fastness to light upon wool tricotine (each by means of the quartz-lamp), and the fastness to light from dyeings upon wool according to the directions of the manufacturers, these values being derived from sunlight tests. Since for numerical valuation of fastness to light the steps 1-5 and 1-8 are in common use, the older values are given as poor, reasonable, fairly good, good, and very good.

		——Quartz-Lamp——		
No.	Dyestuff	Fastness on Clay Plate	Fastness on Wool Tricotine	Fastness in Sunlight
1.	Fulling Yellow H5G.	poor	good	good
2.	Xylene Fast Green B.	poor	fairly good	good
3.	Brilliant Indocyanine G	poor	fair	fairly good
4.	Wool Fast Violet B..	very good	fair	good
5.	Brilliant Sulphone Red B	fair	fair	good
6.	Xylene Fast Orange G	good	good	good
7.	Alizarine Direct Blue ESR	good	very good	good
8.	Sulpho Rhodamine B	fair	very good	fair
9.	Fast Light Yellow G.	poor	good	good
10.	Fast Light Orange...	very good	very good	very good
11.	Amido Red BL.....	good	good	good
12.	Patent Blue V.....	poor	fair	fair
13.	Flavazine E3GL	good	very good	very good
14.	Rhodamine B	fair	very good	fair
15.	Auramine O	very good	very good	poor

In order to be able to compare the tintings on the clay plates with the dyeings upon wool tricotine, the following method was used: the tricotine was dyed with 2.5% of dyestuff, calculated upon the weight of goods, and according to these samlpes the different tint-strips were laid upon the clay plates. Further, fairly strong solutions of the dyestuffs had to be used; the solubility of the dyestuffs was overpassed, however, only in the case of Auramine O; with this dyestuff, undissolved granules of the solid color were upon the plate.

The absolute light-fastness of dyestuffs 1, 2, 3, 5, 9 and 14 is considerably different from that of the dyeings of the same colors upon wool tricotine, whether or not the latter values are determined by the quartz lamp or by sunlight. That the reason for this is not wholly due to the fact that in one case the sample exposed was a physical and chemical combination with the wool fiber, while the other was merely a layer of microscopically fine particles of the dyestuff alone in the pores of the porous plate, is shown by numbers 4, 6, 7, 8, 10, 11, 12 and 13. In these cases the results of the clay plates correspond with those from sunlight. The tricotine dyeings under the quartz lamp were of course difficult to estimate satisfactorily, on account of the above-mentioned yellowing of the wool. These results can therefore be considered as merely approximate. In the case of number 15, it is interesting to observe that in this instance alone is the dyeing upon tricotine faster under the quartz lamp than is the clay plate test. Probably an experimental error is to be suspected here, to be explained by the existence of the dyestuff in a partially undissolved form, as coarse particles, upon the plate. The thick layer of dyestuff presumably allowed only the surface of the layer to be affected by irradiation, and the under-portions were protected by the (altered) surface layer. The dyestuff, however, had to be so applied to the plate in order to match the tint of the tricotine swatch. That, nevertheless, the characteristic action of the mercury arc light had taken place, was proved by examination of the irradiated strip in filtered quartz-lamp irradiation, when it appeared that the strong fluorescence characteristic of Auramine was no longer

present. Number 13, Flavazine E3GL, displays the normal course of light-exposure degradation. And this dyestuff behaved as did Auramine O, when coated upon the clay plate in a thick layer as a solution-paste.

As to the ideal duration of the irradiation, there may be some question, since for actual establishment of the fastness to light it would be sufficient if a dyestuff after a certain number of hours of exposure showed no further change. This period of time could be established by common agreement as a fixed number of hours, when one considers that the light-source, the quartz-lamp, is capable of furnishing light of a constant intensity for a long period. Another fundamental of such an agreement might be, that the period requisite for complete fading of dyestuffs of poor light-fastness be established, and such dyestuffs as showed an alteration of their shade only after the period agreed upon be classified as reasonably fast to light, those which altered only after double that period noted as fairly good, those after three times that time as good, and finally ranking as good and very good those dyestuffs which showed no alteration even after a period of from to four to five times as great.

The results quoted in the table show clearly that the determination of fastness to light according to the method proposed is of a searching and exact nature. It assures one that a dyeing which has been produced with a dyestuff already considered good for its purpose can be guaranteed under the less severe conditions of actual exposure during use of the material. It is essential that the dyestuff be applied to the clay plate in dissolved condition, in order to avoid results which would be quite normal for the conditions, but which would lead to misinterpretation of the results. In quantitative measurements of fastness to light, the clay-plate method appears to promise some advantages. We are thinking now of the decrease in intensity of shade, or degree of fading, which can, with the help of the well-known Zeiss Step-photometer, be carried out on clay-plate substrata more easily and more certainly, than upon wool strands of tricotine swatches. An actual measurement of the dyeing does not come into question in most cases, since the shade upon the clay plates differs greatly from that of a dyed swatch, especially with combinations of dyestuffs.

The clay-plate method of testing light-fastness is perfectly satisfactory for such tests as have to be carried out in practical work. The chief difficulty encountered is that arising from dyestuffs which consist of several components, since the clay plate, like filter-paper, "sucks up" the different components of the dyestuff (solution) at different rates, so that, for example, with a red dyestuff which is composed of a red and a blue, it may occur that the red component penetrates rapidly, by capillary action, into the interior of the clay plate, while the blue is absorbed more slowly; and in this way a larger amount of the blue dyestuff, with a less amount of the red one, is left exposed to the influence of the light. If the fastness to light of the two components is essentally different, an incorrect decision is easily possible, for poor light-fastness of one component can make the compound dyeing worthless. The avoid this possibility of error, strips were cut from the flat clay plates, 15 cm. long and 3 cm. wide. These strips were immersed vertically for a distance of 2 cm. in a solution of the dyestuff to be tested (made up 1 g. to 100 cc. of distilled water; for basic dyestuffs, 1 g. to 500 cc. of water) and left there for 1 hour. During this time a sufficient amount of solution was drawn up, accompanied by capillary separation into the separate components. The clay strips were held upright during the immersion by means of the ordinary retort-stand and clamp used in the laboratory. Such prepared clay strips (dried, of course) were exposed as usual, one-half being protected by a strip of cardboard, and the fastness of the different components determined. The same method, using filter-paper as the absorbing substratum, gave rise to a considerable error through yellowing of the paper; and this would be more serious if only small amounts of a single component were to be tested in the presence of much of the principal component.

Experiments were also carried out with clay tubes, such as are used as protectors for the wires of the clay triangles used in the laboratory for supporting crucibles. In spite of the small lumen of such tubes, no essential improvement in the capillary action, and so in the separation of the compound dyestuff into its components, could be attained. Results were unsatisfactory both because such small objects are not easily kept steady during exposure, and because too little altered and unaltered surface was presented for estimation. Plates of sintered powdered glass, such as are used sometimes in special filtration-apparatus, were also tested, and gave good results. The substratum with these is always white, and can be obtained of such thinness that by the first method, that of painting over with the dyestuff, a serious separation of the components of a compound dyestuff can no longer take place, and, besides, the surface is much more transparent than a clay plate could ever be, and so a more effective irradiation can be given.

In reference to the determination of light-fastness of dyestuffs which fluoresce, it was noted that upon clay plates the fluorescence disappears after a short exposure, even before visible fading has taken place. In the irradiation of tricotine dyed with the same dyestuff, only a decrease in the fluorescence could be noticed. And, furthermore, the use of filtered light from the quartz-lamp makes a more accurate determination of the degree of fading possible, than does examination in sunlight or daylight.

Sizing

Socs "Rhodiaseta"—French Patent No. 655,075.—Applicable to any material. The goods are treated with a semi-drying, oxidized oil emulsified in soap solution, and then passed through a bath containing such salts as will precipitate the soap and the free fatty acids contained in the oil. The goods are then passed through the dryer.

New Laboratory Equipment at Clemson College Textile School

The textile chemistry, rayon and dyeing laboratories at Clemson College (S. C.) Textile School, have been recently remodeled and entirely renovated so as to make room for considerable new equipment which is being installed.

Some of the new equipment recently installed includes a small size combination raw stock and package dyeing machine made by the Columbus Truck and Supply Company, a small Chattanooga cotton raw stock dyeing machine, rubber lined dyeing, bleaching and diazotizing tanks manufactured by the American Hard Rubber Company, a Laundry-Ometer for testing fastness of colors to washing, a Permutit water softening plant, a glass-cell pH determination equipment, considerable new colorimetric pH apparatus, some new rayon manufacturing equipment, a small laboratory centrifuge suitable for small skeins, liquid chlorine bleaching apparatus, sulfur dioxide antichloring equipment, Monel metal rayon dyeing tanks, two new types of spray printing apparatus for textiles, etc.

Among other new equipment now on order are included more large size Monel metal dye tubs, complete pressure kier cotton boiling apparatus of the latest type, temperature control apparatus, more rayon manufacturing apparatus, etc. These will be installed in the near future.

In selecting this apparatus, every effort has been made to select the very best types of equipment possible to demonstrate the actual plant scale operations in the laboratory, with the idea of giving the student every opportunity to gain industrial experience.

Pratt Alumni to Meet

Continuing its annual custom, the Pratt Institute Chemical Alumni Association will celebrate its Thirty-first Anniversary Dinner at 6:30 P. M., April 24, at the Hotel McAlpin in New York. The Secretary, John B. Beach, expects that this will be the largest gathering in the history of the Society and will be only too glad to give any particulars about the reunion to graduates who have not already received an official notification.

General Dyestuff Releases

The General Dyestuff Corporation has sent out circulars calling attention to the manufacture of the General Aniline Works of Fastusol Blue G A which is recommended for use in dyeing of cotton and rayon.

The corporation has also offered Supramine Yellow R A as an acid yellow which is suggested in dyeing from a Glauber's Salt Sulphuric Acid bath. The new brand is particularly recommended for the dyeing of knit goods, woolen and fur hats and also because of its affinity for silk.

Another product of the General Aniline is the Indanthrene Red Violet R R N A paste fine, a vat color in shade and strength similar to that known to the trade as red violet R H type but according to the announcement, slightly yellower and brighter and stronger than the latter.

Pamphlets have been distributed, one on dyeing and one on printing of Katanol O N, a new Katanol brand which, according to the company, will be of interest to the printer because of its white discharge on grounds which are dyed with Katanol O N . Still another product, Fast Blue R R Base, is described and recommended especially for its reddish to greenish blues.

Indanthren Scarlet G G Paste manufactured by the I. G. is likewise announced to the trade as well as Diamine Scarlet 3 B A, a production of the General Aniline Works. General Dyestuff is releasing circulars illustrating the latter color in dyeings on wool, pure silk and on tin-weighted silk.

New Carbic Products

Carbic Color & Chemical Co., Inc., have issued to the trade descriptive pamphlets on Chrome Fast Vesuvine B B; Chrome Fast Vesuvine 2 R and Novochrome, a Fast Brown 3 R D, new mordant specialties for application printing on cotton, viscose and mixed goods. These products were brought out by Durand & Huguenin, S.A. According to the announcement, the colors are distinguished from older types in that they are much faster to soaping, chemic, and light. It is claimed that the new chrome fast Vesuvines are especially suitable for blotch printing and for light shades because of their solubility.

The Novochrome Fast Brown is a concentrated product similar in character and fastness, it is said, to the firm's Chrome Fast Xanthine 2 R.

Mathieson Issues Circular

The Mathieson Alkali Works, Inc., have just published an interesting booklet entitled "Chlorine in Its Newest Form." This brochure describes the properties of their product H T H and of the Hypochloride solutions prepared from it, together with some of the applications that are already found in various fields. A copy of this will be sent gratuitously to anyone addressing the company.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

PURCHASING AGENT

Purchasing agent for textile mill, at present employed, desires new connection. Extensive experience and excellent references. Address: Classified Box No. 597, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.